Cognitive biases in military personnel with and without PTSD. Systematic Literature Review

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TABLE OF CONTENTS

Systematic Literature Review: Cognitive biases in military personnel with and without PTSD

Supervisors: Professor Neil Greenberg & Dr Dominic Murphy

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Background: A number of cognitive biases (memory, attention and judgment) have been implicated in the development and maintenance of PTSD. However, people with PTSD stemming from different sources of trauma may present with different symptom profiles. In particular, military personnel are trained to attend to threat, to assess potential risks in the environment and to make rapid decisions about how to act. Cognitive biases may thus be adaptive in the context of deployment. This review aimed to elucidate the extent to which military personnel with and without PTSD demonstrate cognitive biases.

Methods: Searches of the databases Embase, PsycINFO, PsycARTICLES, Medline and Web of Science were conducted. Studies were included if they made specific reference to cognitive biases, were conducted in a military population and involved direct measurement of PTSD symptoms. Only studies published in peer-reviewed journals, in English, and since 1980 (when PTSD became a formal diagnosis) were included. Studies were excluded if they focused primarily on genetic, neurobiological or physiological factors, or if participants were under the age of 18 or presented with traumatic brain injury or intellectual disability. Study quality was assessed using a selection of questions from the Quality Assessment Tool for Quantitative Studies and the Research Degrees of Freedom Checklist.

Results: 21 studies were included for review. The main finding in relation to memory biases was that military personnel with PTSD tend to be overgeneral when describing autobiographical memories. Most studies focused on attentional bias, and generally tended to be of higher quality. Earlier studies involved a modified Stroop task and found that trauma-related words tended to impair performance to a greater extent for those with vs. without PTSD. Later studies used dot-probe paradigms and conceptualised attentional response as a dynamic process, fluctuating between bias towards and away from threat; military personnel with vs. without PTSD demonstrated greater fluctuation. Other studies using visual search tasks and eye-tracking concluded that attentional bias in PTSD is characterised by interference (difficulty disengaging from threat) rather than facilitation (enhanced threat detection). Finally, there was only one study investigating interpretation bias, a form of judgment bias; this found that military personnel with PTSD tended to complete ambiguous sentences with negative rather than neutral endings to a greater extent than those without PTSD.

Discussion: This review offers a novel contribution to the literature by examining cognitive biases specifically in the context of military PTSD. The relevance for military populations, methodological limitations of the studies and the review, recommendations for future research and implications for clinical practice are considered.

1. INTRODUCTION

1.1 WHAT ARE COGNITIVE BIASES?

Everyday functioning requires people to make sense of the world around them. However, human beings are subjected to a potentially bewildering amount of sensory information at any given time. Processing all this information properly helps to guide behaviour but giving all information equal priority is inefficient and potentially risky. Instead, people are thought to make judgements about situations and decide what to do based on 'heuristics': rules of thumb or mental shortcuts that can reduce cognitive load and facilitate decision-making (e.g. Tversky & Kahneman, 1974). Whilst this strategy is often highly adaptive, the way in which information is processed depends on individual predisposition and experience. Greifeneder et al. (2017) argue that people construct a personal, "subjective social reality", and that it is this social reality rather than objective input that dictates their interpretation of events and behavioural responses. Thus, heuristics can lead to systematic errors or selectivity in the way people process information, referred to as cognitive biases. For example, confirmation bias describes a systematic tendency to search for, attend to and remember information that supports one's preconceptions and to neglect information that contradicts them.

Cognitive biases are extremely common in the general population. However, for some people, these biases are thought to be involved in the development and maintenance of anxiety disorders (e.g. Beard, 2011), including general anxiety disorder (GAD; Hayes and Hirsch, 2007), social phobia (Clark & McManus, 2002), obsessive compulsive disorder (OCD; Williams and Grisham, 2013), panic disorder (Teachman et al., 2007) and post-traumatic stress disorder (PTSD; Buckley, 2000; Constans, 2005). The current review will focus on cognitive biases in PTSD.

1.2 COGNITIVE BIASES IN PTSD

PTSD is characterised by the re-experiencing of traumatic memories (e.g. via nightmares, intrusive thoughts or flashbacks), hypervigilance towards threat, and cognitive and behavioural avoidance in the aftermath of traumatic events. How might cognitive biases be involved in the development and maintenance of these symptom clusters? As described above, people's experiences inform their subjective social reality, leading to selectivity in information processing. Traumatic experiences may lead to an overestimation of threat and a tendency to look for evidence that supports the expectation that threat is imminent and

inevitable (i.e. hypervigilance). Selective processing may also increase opportunities to be reminded of the original trauma, which may lead to re-experiencing symptoms. Biases in how information is appraised may also lead individuals to "keep themselves safe" by staying away from people or places that are perceived as threatening (behavioural avoidance) or by actively trying to suppress traumatic memories or reminders (cognitive avoidance). The research literature emphasises the association between three types of cognitive bias and PTSD (e.g. Constans, 2005); these will now be discussed in turn.

1.2.1 Memory bias

Memory bias refers to systematic impairments or fallacies in the encoding or retrieval of memories, such that recollection of previous experiences is distorted by current knowledge, belief or emotion (Schacter, 1999). For instance, people may exaggerate the consistency between their current and previous beliefs about social issues (e.g. political attitudes), when in reality these may have changed over time (Markus 1986). In the context of PTSD, a core diagnostic feature of re-experiencing symptoms suggests that traumatic memories are highly accessible (McNally et al., 1994). It is therefore plausible that people with the disorder are more likely to remember negative or threat-related versus neutral information (e.g. Moradi et al., 2000), since negative information may be perceived as more relevant or familiar. However, there is also evidence to indicate subtle impairments in memory recall (Buckley et al., 2000).

Research has drawn a distinction between biases in explicit versus implicit memory. Explicit memory refers to the deliberate recollection of factual information (such as autobiographical experiences, facts and concepts; e.g. Ullman, 2004). By contrast, implicit memory typically refers to performance being facilitated by previous experiences *without* deliberate recollection (such as procedural tasks like riding a bike or unconscious priming, e.g. Schacter, 1987). There is an extensive literature on explicit and implicit memory, which is beyond the scope of the current review. However, biases in both explicit and implicit memory have been investigated in the context of anxiety and depressive disorders. For example, one study of explicit memory bias found that people with depression tended to recall more negative than positive words from a previously presented list (Bradley et al., 1995). The literature regarding explicit memory bias in PTSD is somewhat mixed; many studies have found that participants with vs. without PTSD recall more trauma-related words, but there is a high rate of false positives (whereby people report trauma-related words that were never presented; e.g. Paunovic et al., 2002). In one study, participants were presented with pairs of neutral words

and also pairs of words where one was neutral and the other was trauma-related. Although Holocaust survivors with PTSD demonstrated relative deficits in overall recall, they remembered more trauma vs. neutral words, an enhancement effect which was not found for Holocaust survivors without PTSD or matched controls (Golier et al., 2003). This suggests that PTSD may facilitate associative learning of trauma-related information.

In contrast with explicit memory tasks, tests of implicit memory bias can include procedural learning (e.g. mirror-drawing) and priming tasks (of which there are multiple types; see Schacter, 1992 for a review). An example of a priming task might involve target words being presented and a seemingly unrelated task (e.g. word-completion) being performed after a delay. Implicit memory bias is indicated if participants automatically generate target words in the latter task without being instructed to do so. Although implicit memory bias has been implicated in some anxiety disorders (Coles & Heimberg, 2002), previous reviews have found limited evidence in PTSD (Constans, 2005). For instance, the study of Holocaust survivors described above (Golier et al., 2003) involved a second, implicit memory task (involving word-stem completion); this revealed no differences in implicit memory bias for survivors with and without PTSD.

The studies described above may help to clarify how memory biases influence people with PTSD when they are learning and remembering new information. However, the paradigms used in these studies have been criticised for their limited ecological validity. Moreover, the inclusion of trauma-related words may not necessarily assess memory bias for highly personal traumatic events (Constans, 2005). In contrast with studies of explicit or implicit memory bias, other studies have described autobiographical memory biases, such as overgeneral memory bias (e.g. Williams & Broadbent, 1986). This refers to the tendency to describe broad categories of events rather than one specific occurrence. A small number of studies suggest that an overgeneral autobiographical memory bias exists in PTSD (e.g. Wessel et al., 2002), with one study also indicating that overgeneral memory in acute stress disorder is predictive of developing PTSD in the future (Harvey et al., 1998). It has been suggested that for people with PTSD, this bias arises from a deliberate strategy of avoiding specific trauma memories in order to manage emotional distress, and that this in turn leads to memory retrieval processes that lack specificity (Williams, 1996; Brewin et al., 1999).

Taken together, there is some evidence to suggest that people with PTSD display explicit memory bias, whereby they encode or retrieve trauma-related information more readily than

more innocuous information, and autobiographical memory bias, whereby they recall overgeneral categories more readily than specific events.

1.2.2 Attentional bias

Attentional bias refers to the tendency to allocate attention towards stimuli that are perceived as threatening. The capacity to redirect attention towards danger or strong threat is evidently an adaptive strategy (Mogg & Bradley, 1998). However, people with high levels of anxiety are sensitive to even mildly threatening stimuli. Continuous attentional bias towards mild threat may lead to increased stress and chronic hyperarousal, thus contributing directly to the development and maintenance of PTSD (Mathews & MacLeod, 2002). Two paradigms have been widely used to investigate attentional bias: emotional Stroop and dot probe.

In the classic Stroop task (Stroop, 1935) participants are presented with colour words (i.e. red, green, blue) that are printed in either a matching ink colour (congruent condition; the word red in red ink) or mismatching ink colour (incongruent condition; the word red in green ink); they are then asked to name the ink colour (rather than read the colour word). People are typically slower on incongruent trials, highlighting an interference effect. In contrast, people are faster on congruent trials than when presented with neutral stimuli (e.g. red, green and blue squares), highlighting a facilitation effect. Both these effects are thought to be underpinned by the automaticity of reading. A substantial body of literature has adopted a modified version of the Stroop task (Modified Stroop Task; MST) to investigate attentional bias in anxiety disorders (e.g. Ben-Haim, et al., 2016). In this version of the task, participants are again asked to name the colour of the ink that words are printed in, but the words presented are either neutral or emotionally salient. Selective interference effects are thought to reflect the fact that emotionally salient words are more likely to capture attention and thus slow reaction time than neutral words. Numerous studies have demonstrated that regardless of the source of trauma, PTSD is associated with increased attentional capture for trauma-related words in the MST (Constans, 2005).

In the dot probe task, participants view a fixation cross at the centre of a computer screen, after which two stimuli (one neutral, one threatening) are presented simultaneously on either side of the screen for a brief, predetermined length of time (e.g. 500 milliseconds, although numerous studies have experimentally manipulated the duration of exposure). A target 'dot' is then presented in the same position as one of the previous stimuli, and participants are asked to indicate the location as rapidly as possible. Vigilance to threat is thought to be

indicated by faster reaction times when the dot appears in the 'threat' position than the 'neutral' position. A number of studies have measured attentional biases in anxiety disorders using the dot probe paradigm (Bar-Haim et al., 2007), but the evidence in relation to PTSD specifically has been mixed, with some studies linking PTSD with a bias towards threat and others with bias away from threat (Ashley et al., 2013; Schafer et al., 2016). The inconsistency of findings suggests that there may be fluctuations in attentional bias; this reflects PTSD symptomatology, since people with PTSD are both vigilant to and avoidant of threat. A metric that captures some of this variability in attention may provide a promising means of investigating differences between those with and without PTSD. Indeed, attentional bias has been more recently conceptualised as a dynamic process "expressed in fluctuating, phasic bursts, toward and/or away from target stimuli over time" (Zvielli et al., 2015).

Despite the mixed findings yielded using the dot probe paradigm, a number of studies have employed the task as a means of ameliorating attentional bias, with some success. These studies involve repeated sessions in which the dot is systematically positioned in the location of the non-threatening stimulus in order to train attention away from threat (Bar-Haim, 2010), or where the dot is presented with equal frequency in both locations in order to enhance attentional control (Wald et al., 2016). There is also some evidence that this training can ameliorate symptoms of PTSD (Wald et al., 2016).

In summary, there is substantial evidence to suggest that in comparison with healthy controls, people with PTSD demonstrate attentional bias; they are more sensitive to and easily distracted by mildly threatening stimuli.

1.2.3 Judgment Biases

Biases in judgment are thought to contribute to elevated anxiety and to the maintenance of PTSD symptoms (Ehlers & Clark, 2000). This is because a systematic tendency to judge the world as threatening may perpetuate feelings of fear and vulnerability and reinforce avoidance behaviours. Two specific biases in judgement are thought to be theoretically relevant to PTSD: subjective risk bias and interpretation bias (Constans, 2005). Subjective risk bias describes an increased perception of threats in the environment and the tendency to overestimate the likelihood of negative events taking place in future. For instance, symptoms of acute stress and PTSD are associated with a propensity to judge future negative events as more probable and costlier (Thrasher & Dalgleish, 1999; Warda & Bryant, 1998).

As opposed to future-focused, subjective estimates of risk, interpretation bias describes the way in which people make judgements about current, ambiguous information. In the context of PTSD and other anxiety disorders, researchers have focused on paradigms that present words or sentences that may have threatening or non-threatening meanings. For example, in one task, anxious participants read homophones (such as die/dye) out loud and were asked to spell them, to see whether they would choose the threatening or non-threatening spelling (Eysenck et al., 1987). One study found that participants with PTSD were more likely to end ambiguous sentences with trauma-related words than those without (Kimble, 2002), implying a bias towards threatening interpretations of ambiguous information.

Despite a clear theoretical rationale, very few studies appear to have investigated subjective risk bias or interpretation bias in PTSD; doing so may help to illuminate any systematic errors in the ways in which people with PTSD make judgments about current and future threat.

1.3 TRAUMATIC EXPERIENCES

1.3.1 Relevance of type of trauma

There is currently a lack of clarity in the literature regarding how cognitive biases might operate in those with PTSD originating from different sources of trauma. Individuals may meet the criteria for a diagnosis of PTSD after experiencing a diverse range of traumatic incidents. These traumatic incidents may have different properties with different outcomes, and lead people to hold different sorts of beliefs. For instance, there is some evidence that people who have experienced natural disasters may be most likely to view the world as an unjust and unpredictable place (e.g. Garcia et al., 2015) and must cope with numerous secondary stressors such as severe and enduring social and economic consequences (e.g. the loss of one's home). By contrast, survivors of an assault may have prominent beliefs about other people as dangerous and untrustworthy or about themselves as weak or defective in some way (e.g. Ali et al., 2002). PTSD symptoms experienced by assault-survivors can also vary depending on the type and severity of assault (Hembree et al., 2004), as well as peri-traumatic factors such as whether the victim experienced 'mental defeat', whereby one's sense of self is threatened (Ehlers et al., 2000).

1.3.2 Cognitive bias and military PTSD

Differences in the severity, symptom profile and chronicity of PTSD may also be observed depending on whether the indexed trauma was a brief, one-off event (such as assaults or motor vehicle accidents) or a more prolonged and enduring period of stress, which may be

more common within military populations. Unsurprisingly, members of the armed forces (and other professions such as the police or emergency services that involve high levels of exposure to distressing situations) are at particular risk for developing PTSD (Stevelink et al., 2018). In addition to increased prevalence, symptom severity in veteran versus civilian populations appears to be greater, even when exposed to traumatic events of a similar magnitude (Brinker et al., 2007). For instance, research studies have found that people hospitalised due to combat are more likely to report re-experiencing and hyperarousal than those hospitalised for other traumatic events (Gaylord et al., 2004) and combat veterans present with more symptoms of hyperarousal than victims of sexual abuse (Henigsberg et al., 2001).

Beyond prevalence and symptom severity, there are specific characteristics associated with PTSD that may be particularly relevant for military personnel. They may experience a diminished sense of identity (Brewin, et al., 2010), associated with a change in role when returning from active service, and they may feel alienated from society or as though their service was underappreciated (Shay, 2002; Childers, 2009). One possible explanation of this is that unlike many other sources of trauma, traumatic experiences arising from deployment are likely to take place outside of one's usual environment. This presents an additional dimension when considering the development and maintenance of military PTSD: adjustment difficulties when reintegrating into civilian life. This is thought to pose a significant challenge; for example, although warzone-related difficulties such as social isolation or poor unit cohesion are linked to negative health outcomes, veterans with PTSD are also adversely affected by difficulties at home (Browne et al., 2007). Adjustment difficulties may include strained familial relationships (Gold et al., 2007) and other aspects of functional impairment such as difficulty obtaining or sustaining employment after leaving service, social functioning, and substance misuse (Maguen et al., 2009).

How might adjustment difficulties relate to the role of cognitive biases in military PTSD? As described above, many cognitive biases are adaptive ways to make rapid, efficient decisions. Military deployments are often inherently threatening, and thus the ability to recall threat-related information readily, to attend rapidly to threat and to assess risks when deciding on behaviour are effective strategies in that particular context (Castro et al., 2015). Nonetheless, this threat vigilance, whilst adaptive in military environments, has been found to predict post-combat PTSD symptoms (Wald et al., 2013). It remains unclear as to whether military

personnel with similar experiences of combat exposure who go on to develop PTSD make similar cognitive appraisals to those who do not.

In summary, whilst cognitive biases are a core feature of PTSD regardless of the source of trauma, there is a strong theoretical case to be made for focusing on how these processes operate in the context of specifically military PTSD.

1.4 CURRENT REVIEW

In summary, cognitive biases such as excessive attention to threat after an isolated traumatic event might represent a departure from the norm for many people with PTSD. This may not be the case for military personnel with PTSD, who are potentially accustomed to remaining vigilant to threat when deployed. For this population, adjustment to civilian life, with objectively fewer day-to-day threats, might present a significant challenge. Despite the ample evidence for cognitive misappraisals in PTSD, no systematic review to date has explored these processes specifically within military populations. This is an important line of inquiry, since service personnel often have to operate under prolonged stress during which sensitivity to perceived dangers and a tendency to interpret ambiguous information as threatening may in fact be highly adaptive, irrespective of subsequent PTSD symptomatology (Castro et al., 2015). The extent to which military personnel with versus without PTSD differ in their cognitive appraisals is thus unclear. The current review aimed to address this question by systematically examining the evidence base for the role of specific cognitive biases implicated in military PTSD.

Whilst cognitive biases are considered central to cognitive accounts of PTSD, Nanney et al. (2015) argued that much of the literature uses inconsistent definitions of the term. They drew a distinction between *processes* and *products*. Processes refer to active, online appraisals of incoming information whereas products primarily refer to beliefs (e.g. specific cognitions about the self, world or other people). Nanney et al. (2015) concluded that products arise from processes. For instance, attending disproportionately to threat (process) leads to the belief that the world is unsafe (product). In line with this argument, and consistent with early research from the experimental cognitive psychology literature, the current review only included research that examines processes rather than products. Specifically, the constructs of memory bias, attentional bias, subjective risk bias and interpretation bias will be examined, since these have been highlighted as particularly relevant to PTSD.

2. METHODS

2.1 SEARCH STRATEGY

The databases Embase, PsycINFO, PsycARTICLES, Medline and Web of Science were searched for the current review. The search was carried out between 12th-15th October 2018 using the following search strategy:

- The search terms cognitive appraisal*, appraisal*, cognitive misappraisal*, misappraisal*, misinterpretation*, cognitive bias*, negative cognition*, interpret* bias and attent* bias were combined using the OR Boolean operator
- The search terms PTSD, posttraumatic stress disorder and post-traumatic stress disorder were combined using the OR Boolean operator
- The search terms military and veterans were combined using the OR Boolean operator
- The results from each of the above three searches were combined using the AND Boolean operator

In addition to this search strategy, Google scholar citations and reference lists of review papers were searched for relevant studies. Each stage of the search process is outlined using the PRISMA flowchart (see Figure 3.1).

2.2 INCLUSION/EXCLUSION CRITERIA

All studies meeting the following criteria were included:

- Those that made reference to specific cognitive biases, appraisals or thinking styles (e.g. attentional bias, interpretation bias, subjective risk bias or memory bias). This was to ensure that the scope of the review was manageable and to focus on the cognitive *processes* involved in making appraisals rather than the *content or product* of appraisals (e.g. specific negative thoughts or beliefs), since this is thought to carry the greatest relevance for the development and maintenance of PTSD.
- In line with the aims of this review, only studies involving military or veteran populations.
- In line with the aims of this review, only studies where PTSD symptomatology was directly measured
- Only studies appearing in peer reviewed journals
- Only studies in English

All studies meeting the following criteria were excluded:

- Studies conducted prior to 1980, when PTSD became a formal diagnosis
- Studies focusing primarily on genetic, neurobiological or physiological factors
- Studies where participants presented with traumatic brain injury or intellectual disability
- Studies involving participants under the age of 18

2.3 QUALITY ASSESSMENT

2.3.1 Quality assessment tools

The quality of the studies in the current systematic review was measured using selected questions from two separate tools: the Quality Assessment Tool for Quantitative studies (QATQ) and the Researcher Degrees of Freedom Checklist (RDFC).

2.3.1.1 Quality Assessment Tool for Quantitative Studies (QATQ)

The QATQ is a standardised tool that was developed as part of the Effective Public Health Practice Project (EPHPP; 1998) and is suitable for any articles related to a public health topic. It comprises eight domains, each of which receives a rating of 'strong', 'moderate' or 'weak' based on specific criteria outlined in a supplementary dictionary. The first six criteria (selection bias, study design, confounders, blinding, data collection method and withdrawals and dropouts) combine to give a global rating. This tool has been found to have acceptable content validity and test-retest reliability (Thomas et al., 2004). This tool was selected primarily for its methodological rigour and relevance for health-related research. However, the QATQ and other quality assessment tools (such as checklists developed by the Critical Appraisal Skills Programme; CASP) are primarily used to assess the quality of randomised control trials (RCTs), which are considered the gold standard in public health research focused on establishing the efficacy of an intervention. In contrast, the aims of the current review were to evaluate experimental research that has focused on specific cognitive mechanisms as opposed to a health intervention. Thus, many commonly-used quality assessment tools were not deemed suitable for the current review, and only 3 of the 6 QATQ domains that comprise a global methodology rating were used to assess the quality of studies in this review:

- Selection bias: the extent to which study participants are likely to be representative of the target population. Participants are very likely to be representative if randomly

selected from a comprehensive list of individuals in the target population (e.g. all soldiers from a specific battalion, brigade or geographical region). Participants are somewhat likely to be representative if referred from a source (e.g. a clinic) and are unlikely to be representative if self-referred.

- Confounders: the extent to which confounding variables have been controlled for, either in design (by stratification or matching) or in the analysis.
- Data collection methods: the extent to which outcome measures are described as reliable and valid.

The remaining three domains (study design, blinding and withdrawals and dropouts) are most applicable in relation to research articles describing an intervention and will therefore not be included in the formal quality assessment.

2.3.1.2 Researcher Degrees of Freedom Checklist

Few tools have been developed and evaluated to assess the quality of experimental studies. The RDFC was developed to address a key criticism of experimental research in psychology: decisions made in the planning, design, analysis and reporting of studies are often somewhat arbitrary and can thus lead to an increased chance of false positives (Type 1 errors) and to inflated effect sizes, which often lead to findings that cannot be replicated. The checklist is primarily for researchers to make more sound methodological decisions when conducting a study or for reviewers to assess the quality of preregistered studies; after a study has been published, it is difficult to establish whether all the criteria have been met. For example, one cannot tell from reading a paper whether the researchers continued recruiting until a significant p-value was obtained, measured multiple additional variables and dropped non-significant ones, determined hypotheses after results were known or engaged in any other questionable research practices. Nonetheless, a subset of the checklist criteria can be used to assess research quality following publication:

- Conducting explorative research without any hypothesis OR studying a vague hypothesis that fails to specify the direction of the effect
- Creating multiple manipulated independent variables and conditions OR measuring the same dependent variable in several alternative ways
- Failing to conduct a well-founded power analysis

2.3.2 Quality scoring

Studies were rated on six aspects of quality, based on the combined QATQ and RDFC criteria, on a 0-2 point scale, giving a maximum score of 12 (see Appendix). 20% of articles were scored by a blind, independent second assessor to ensure reliability.

3. RESULTS

3.1 SEARCH RESULTS

See Figure 1 for a comprehensive overview of the search results. The initial search yielded 90 results from Embase, 145 from PsycINFO, 463 from PsycARTICLES, 82 from Medline and 273 from Web of Science. Searches of additional sources (reference lists; Google Scholar citations) returned nine further results, giving a total of 1062 articles. 801 articles remained after duplicates were removed. The titles and abstracts of these articles were then screened for relevance and 772 articles were excluded at this stage. The main reasons for exclusion included no reference to a cognitive bias, no specific focus on PTSD, study participants had no military background, study participants had comorbid traumatic brain injury, or studies described primarily genetic or neurobiological factors.

The full text of the remaining 31 articles was then examined. One of the aims of the current review was to elucidate any differences in cognitive biases between military personnel with and without PTSD. On these grounds, a further six studies were excluded since they only included participants presenting with symptoms of PTSD, without a control group for comparison. One study was also excluded since participants were drawn from a traumatic brain injury clinic. Another study was excluded since the control group was not from a military background. One further study was excluded since it included a measure of PTSD symptomatology, but no participants met the clinical threshold. Lastly, one study was excluded since it described a behavioural rather than cognitive bias (focusing on physically approaching versus avoiding threat). Thus, a final set of 21 studies were included for review.

3.2 PARTICIPANT CHARACTERISTICS

An overview of the participant characteristics in all included studies is described in detail in Table 3.1. Across the 21 studies, the total number of participants was 1977. In line with the research on military PTSD, participants in the studies were overwhelmingly male. With respect to conflict, participants in 11 studies were veterans from the Vietnam war, participants in seven studies were current or ex-soldiers involved in Operation Enduring Freedom (OEF; the US war in Afghanistan) and/or Operation Iraqi Freedom (OIF; the US-Iraq war). The conflict was not specified for the remaining three studies (with participants recruited from state veterans' organisations/clinics etc.). It is worth noting that 18 of the 21 studies involved participants who were current or ex-members of the US armed forces; two

studies recruited participants from the Israeli armed forces and the final study recruited German soldiers; the current review did not find any studies examining cognitive biases in UK military populations with and without PTSD.

With respect to the approach taken in the reviewed studies, 16 were experimental studies directly contrasting those with and without PTSD on a measure of cognitive bias. Three of these studies also involved a civilian control group. The five remaining studies examined cohorts of soldiers pre- and/or post-deployment and correlated measures of cognitive bias with PTSD symptomatology. Some of these studies aimed to elucidate factors that are predictive of PTSD post-deployment; others investigated whether bias modification or training programmes could be used as a preventative measure, to reduce the likelihood of individuals developing PTSD post-deployment.

Figure 3.1: PRISMA flowchart describing screening process and eligibility assessment

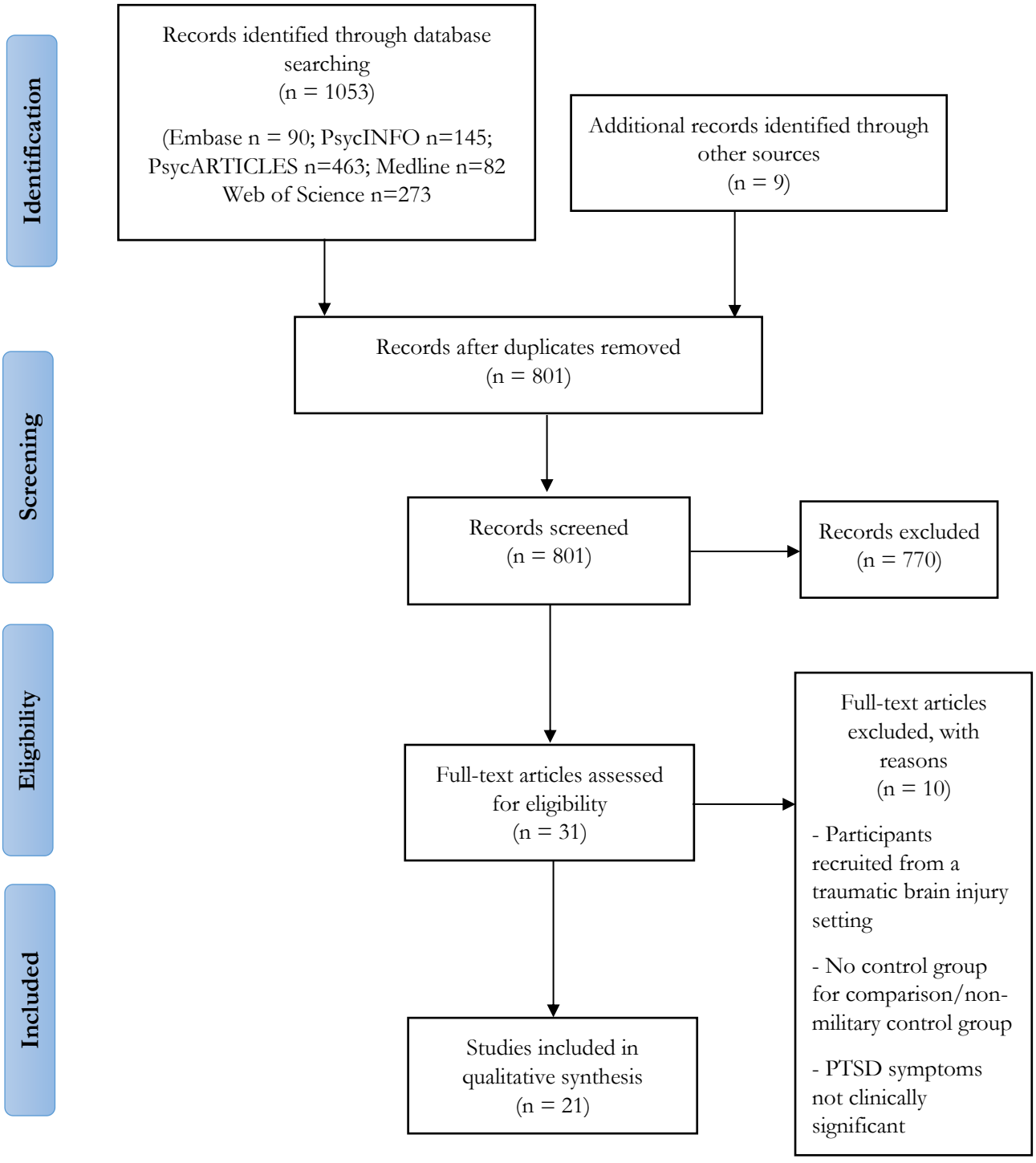

Table 3.1: Study characteristics

Study	*Sample*	*Country*	*N*	*Age*	*Gender*
1. McNally et al., 1990	Vietnam veterans with/without PTSD	USA	30	PTSD: 40.07; Non-PTSD: 43.40	100% male
2. Zeitlin & McNally, 1990	Vietnam veterans with/without PTSD	USA	48	PTSD: 41.13; Non-PTSD: 43.88	100% male
3. McNally et al., 1994	Vietnam veterans with PTSD, alternative diagnoses and veteran controls	USA	82	Not reported	100% male
4. McNally et al., 1995	Vietnam veterans with/without PTSD	USA	32	PTSD: 46; Non-PTSD: 49	100% male
5. Kaspi et al., 1995	Vietnam veterans with/without PTSD	USA	60	PTSD: 41.6; Non-PTSD: 44.3	100% male
6. Vrana et al., 1995	Vietnam veterans with/without PTSD	USA	57	PTSD: 44.8; Non-PTSD: 47.9	100% male
7. McNally & Amir, 1996	Vietnam veterans with/without PTSD	USA	28	Not reported	100% male

Study	*Sample*	*Country*	*N*	*Age*	*Gender*
8. Amir et al., 1996	Vietnam veterans with/without PTSD	USA	28	PTSD: 47.3; Non-PTSD: 47.5	100% male
9. Kimble et al., 2002	Vietnam veterans with/without PTSD	USA	28	52.4	100% male
10. Pineles et al., 2007	Vietnam veterans with/without PTSD	USA	57	PTSD: 54.69; Non-PTSD: 54.30	100% male
11. Armstrong et al., 2013	Afghanistan/Iraq veterans with/without PTSD & civilian controls	USA	58	PTSD: 32.62; Non-PTSD: 34.69; Civilian: 32.81	>90% male
12. Ashley et al., 2013	Afghanistan/Iraq veterans with/without PTSD & civilian controls	USA	90	PTSD: 32.3; Non-PTSD: 33.6; Civilian: 32.2	>90% male
13. Olatunji et al., 2013	Veterans with/without PTSD & civilian controls	USA	58	PTSD: 33.55; Non-PTSD: 34.69; Civilian: 32.86	>90% male
14. Wisco et al., 2013	Vietnam veterans	USA	61	54.75	100% male

Study	*Sample*	*Country*	*N*	*Age*	*Gender*
15. Constans et al., 2014	Afghanistan/Iraq veterans with/without PTSD & with/without overreporting style	USA	124	33.84	89.5% male
16. Sipos et al., 2014	Soldiers post-deployment to Iraq	USA	63	Not reported	86% male
17. Khanna et al., 2016	Afghanistan/Iraq veterans with/without PTSD	USA	41	Not reported	100% male
18. Schafer et al., 2016	Soldiers pre and post-deployment to Afghanistan	Germany	158	Baseline 26.3; Follow-up 27.8	100% male
19. Wald et al., 2016	Soldier pre and post-deployment	Israel	719	19.3	100% male
20. Swick & Ashley, 2017	Afghanistan/Iraq veterans with/without PTSD	USA	56	PTSD: 35.14; Non-PTSD: 38.32	>90% male
21. Wald et al., 2017	Soldiers pre-deployment	Israel	99	20.4	100% male

Table 3.2: Key findings and quality assessment

Study	*Bias*	*Task*	*Key findings*	*Quality score (max=12)*
1. McNally et al., 1990	Attention	Modified Stroop	Interference effects on emotional Stroop for PTSD group only, specifically to trauma words (and not positive emotional words)	9
2. Zeitlin & McNally, 1990	Memory	Implicit & explicit cued recall	Evidence of both implicit and explicit memory bias towards threat vs. non-threat words in PTSD	7
3. McNally et al., 1994	Memory	Autobiographical memory retrieval	Overgeneral memory characterised PTSD and depression; exposure to traumatic reminders exacerbated overgenerality only for participants with PTSD and not those with depression	8
4. McNally et al., 1995	Memory	Autobiographical memory retrieval	Participants with vs. without PTSD described more overgeneral memories, particularly with positive cues	7
5. Kaspi et al., 1995	Attention	Modified Stroop	Combat-related words produced greater interference than neutral/positive/other negative words, and this was exacerbated in those with PTSD.	7
6. Vrana et al., 1995	Attention	Modified Stroop	Participants with PTSD were slower on the task overall, and interference effects for anxiety-related words were more pronounced for PTSD participants.	9

Study	*Bias*	*Task*	*Key findings*	*Quality score (max=12)*
7. McNally & Amir, 1996	Memory	Implicit memory for visually-presented words	No evidence found for memory bias for trauma-related words	5
8. Amir et al., 1996	Memory	Implicit memory for auditorily-presented sentences	Implicit memory bias for combat-related sentences for PTSD participants but not controls	9
9. Kimble et al., 2002	Interpretation	Sentence completion	Veterans with PTSD produced significantly more military endings than non-military endings to sentences, indicating interpretation bias	9
10. Pineles et al., 2007	Attention	Visual search	Interference effects of threat words, but not facilitated detection of threat words, found for high vs. low PTSD participants	10
11. Armstrong et al., 2013	Attention	Eye-tracking	PTSD characterised by sustained attention towards threat but not facilitated detection	10
12. Ashley et al., 2013	Attention	Modified Stroop	PTSD participants had slower reaction times Overall; this was exacerbated for combat-related words. PTSD participants habituated but at a delayed rate compared to either control group	10

Study	*Bias*	*Task*	*Key findings*	*Quality score (max=12)*
13. Olatunji et al., 2013	Attention	Rapid serial visual presentation	PTSD participants' performance was impaired, but only for combat-related threat distractors (rather than generally negative stimuli), indicating increased attentional capture and difficulty disengaging	10
14. Wisco et al., 2013	Attention	Visual search	Thought suppression and worry mediate the relationship between attentional interference and re-experiencing/ avoidance symptoms of PTSD	10
15. Constans et al., 2014	Attention	Modified Stroop	Overreporting bias augments the modified Stroop effect in veterans with PTSD. This suggests that overreporting reflects overall distress rather than malingering	6
16. Sipos et al., 2014	Attention	Dot probe	With low combat exposure, attentional performance and PTSD symptoms appeared unrelated. However, with high combat exposure, participants with slower response to threat stimuli reported higher PTSD symptoms.	8
17. Khanna et al., 2016	Attention	Modified Stroop and Attention training using dot probe	Only participants with PTSD exhibited combat-related Stroop interference. Attention training (especially) attentional control training) improved task performance.	10
18. Schafer et al., 2016	Attention	Dot probe	Separating attentional bias into 'towards', 'away', and 'temporal variability' predicted PTSD symptoms post-deployment; traditional aggregate mean bias scores did not	10

Study	*Bias*	*Task*	*Key findings*	*Quality score (max=12)*
19. Wald et al., 2016	Attention	Attention training using dot probe	The most effective preventative intervention (producing significantly lower levels of post-deployment PTSD) was low-dose attentional bias modification training	11
20. Swick & Ashley, 2017	Attention	Dot probe	PTSD participants were slower overall. No group differences in bias towards or away from threat emerged. The PTSD group showed greater fluctuations in attentional bias than controls.	9
21. Wald et al., 2017	Attention	Attention training Using dot probe	Training on attentional bias, but not attentional control, moderated the association between combat exposure and PTSD symptoms	10

3.3 OVERVIEW OF STUDIES

Table 3.2 describes the cognitive bias examined in each article, the paradigm or task used to measure this bias, the key findings and a total quality score.

3.3.1 Research relating to memory bias in military PTSD

The current review revealed five studies that have examined memory biases in combat veterans with and without PTSD. In the first, Zeitlin and McNally (1991) aimed to examine both explicit and implicit memory bias. Participants were presented with neutral and trauma-relevant words, and then then completed an implicit recall task for half the words, in which they were instructed to complete word stems with any word they liked, and an explicit recall task, whereby they were instructed to complete word stems with the word from the original list. With respect to explicit recall, participants with PTSD demonstrated a *relative* (but not absolute) memory bias, recalling more combat-related than neutral words, but not in comparison with the control group. With respect to implicit recall, the effects of priming were greater for combat-related words than other words, but only in the PTSD group. The authors concluded that there was evidence for both implicit and explicit memory bias in participants with PTSD. However, it should be noted that the implicit and explicit memory tasks were very similar, since both involved completing word stems.

Two subsequent studies claimed to focus exclusively on implicit memory bias. In the first study, McNally & Amir (1996) presented combat veterans with and without PTSD with trauma-related, positive and neutral words, half of which had been presented before. The words were presented very briefly and then masked. Both groups demonstrated perceptual priming by accurately identifying a greater number of old versus new words, but there was no enhancement effect for trauma words in the PTSD group. In the second study, Amir et al. (1996) presented combat veterans with and without PTSD with combat-related and neutral sentences, half of which had been presented before. The sentences were accompanied by background noise of varying volume. The findings revealed that participants with PTSD demonstrated an implicit memory bias for combat-related sentences to a greater extent than those without PTSD, but only under the high-volume condition. Thus, the first study did not find evidence for group differences in bias and the second study did. What could account for the inconsistency in findings? One key difference between the two studies was the task used to measure implicit memory bias. The first study (McNally & Amir, 1996) used words as stimuli, and the researchers considered the possibility that doing so may emphasise orthographic or lexical rather than semantic features. By contrast, the use of sentences in the

second study (Amir et al., 1996) arguably provided more context and therefore had greater semantic meaning. In this study, lower estimates of background noise volume for old vs. new sentences was interpreted as evidence for implicit memory bias, based on the argument that there is reduced interference for familiar or easily processed information. The finding that only participants with PTSD demonstrated an implicit memory bias for combat-related sentences led the authors to conclude that threat-related information may be automatically accessed in PTSD. However, it should be noted that group differences were only revealed when the background noise was high in volume, indicating a relatively subtle effect of implicit memory bias. Most importantly, the tasks described thus far, involving either implicit/explicit variants or repeated exposure to stimuli, comprise conditions that take place in relatively quick succession, without a delay. Thus, it is possible that participants' performance in all of these studies was contaminated by recent viewing of specific target stimuli. Whilst a contamination effect does not necessarily account for group differences, the extent to which the authors can claim to genuinely measure distinct aspects of memory bias is unclear.

The current review revealed two final studies examining autobiographical memory bias. McNally et al. (1994) argued that whilst the laboratory paradigms used to examine memory biases are methodologically rigorous, they lack ecological validity, and stimulus sets involving single trauma-related words are at best a proxy for the richer, vivid autobiographical memories characteristic of PTSD. In an attempt to address this, McNally et al. (1994) and McNally et al. (1995) asked participants to retrieve specific autobiographical memories in response to neutral, positive and negative cue words. These studies found that veterans with PTSD were more likely to describe overgeneral rather than specific memories than those without PTSD. This overgenerality was exacerbated following exposure to traumatic reminders, which supports the view that this memory bias serves the function of protecting individuals from the emotional distress associated with traumatic memories. One post-hoc observation in McNally et al. (1995) was that overgenerality effects were also exacerbated for veterans who happened to be wearing war-related regalia during the study. The authors tentatively suggested that wearing war regalia in daily life may represent a constant reminder of or psychological fixation to combat-related traumatic memories, which in turn enhances autobiographical memory bias.

In summary, very few studies have been conducting that examine memory biases in military personnel with and without PTSD. There is mixed, relatively weak evidence for implicit and

explicit memory biases in PTSD, and somewhat more consistent stronger evidence for an autobiographical memory bias. Specifically, military personnel with PTSD in the reviewed studies appear to be overgeneral when describing their memories. Overgenerality was revealed for both positive and negative memories. It is thus possible that autobiographical memory bias contributes to the maintenance of PTSD in two ways. Firstly, by avoiding specific aspects of trauma memories, the memory is not properly processed and remains easily accessible. Secondly, by avoiding specific aspects of positive memories, people have limited opportunity to improve their mood or to challenge negative beliefs with contradictory evidence. However, given the limited number of studies and the quality of evidence available, further research is needed to elucidate the potential role of memory bias in military PTSD.

3.3.2 Research relating to attentional bias in military PTSD

The vast majority of the studies in the current review related to attentional bias in PTSD. Of these studies, six used the modified Stroop task (MST), five used a dot probe paradigm, one used both MST and dot probe, three used visual search paradigms and the final involved eye-tracking technology. The key conclusions pertaining to each type of paradigm will now be discussed in turn.

3.3.2.1 Attentional bias and the modified Stroop task (MST)

The earliest study examining attentional bias in military personnel with and without PTSD using the MST was conducted by McNally et al. (1990). The authors argued that poor processing of trauma memory and associated re-experiencing phenomena indicate that cognitive representations of trauma reside in a primed or partially activated state in memory. They use this as theoretical justification for using the MST (since trauma words relating to partially activated cognitive representations should produce greater attentional interference than neutral words). In this preliminary study, veterans with and without PTSD were presented with trauma-related, OCD-related, positive and neutral words in the MST format. As described above, this involves participants naming the ink-colour words are presented in, with the expectation that more emotionally salient words will produce greater interference effects (i.e. reaction time delays). In line with predictions, veterans with PTSD took longer to respond to trauma-related words than any other word type; control group did not exhibit this interference effect. This suggests that PTSD symptoms rather than combat exposure were responsible for attentional interference. The fact that the interference effect was only for trauma-words in the PTSD group led the authors to conclude that attentional interference in PTSD is specific to trauma memories rather than other negative or disorder-related stimuli

or other emotionally salient (e.g. positive) stimuli. However, it is possible that the emotional valence of trauma-related words is stronger (more negative) than positive words, and that interference effects could reflect general emotionality rather than traumatic content. Even though OCD-related words were used as an alternative set of disorder-related, negative stimuli, these were words such as "germs" which were unlikely to have had the same emotional salience (for non-OCD sufferers) as words such as "bodybags". Moreover, using independently-rated words as stimuli may be a flawed approach, since traumatic memories are highly subjective. Kaspi et al. (1995) aimed to address these concerns by creating personalised stimulus sets for use with the MST, based on participants' subjective ratings of the emotionality of target words, and found that participants with PTSD had greater interference for combat-related words than for neutral, positive or negative non-trauma words.

In contrast to earlier studies, Vrana et al. (1995) found that negative words that varied with respect to their direct relevance to combat all produced interference effects relative to neutral words. The study also revealed that veterans with PTSD were able to recall more emotional words (but not more neutral words) than veterans without PTSD. This suggested that MST interference effects were mediated by attentional bias towards emotionally salient words, rather than distraction caused by attentional avoidance of threat-related information. Nonetheless, given that PTSD is characterised by both vigilance towards threat and avoidance of threat, further research is needed to unpick the mechanisms underpinning attentional bias. Unlike the McNally et al. (1990) study, both the subsequent studies described above found that healthy combat veterans demonstrated the same relative interference for traumatic vs. neutral words, but to a lesser extent than those with PTSD. However, no civilian control group was included, and so the relative contributions of trauma exposure and PTSD symptomatology cannot be elucidated.

More recent studies involving the MST have emphasised other aspects of attentional bias. Firstly, Ashley et al. (2013) recognised that previous studies examining the MST in military PTSD have involved combat veterans from the Vietnam war, and wished to confirm that findings extended to veterans in more modern-day conflicts; they also wished to investigate the extent to which habituation to emotional stimuli can be elicited using the MST. In order to address both these aims, their study involved veterans who had been involved in the wars in Afghanistan and/or Iraq and involved completing the MST across multiple blocks. They built on the attentional interference findings from previous research: veterans with PTSD

were slower and less accurate overall and had significantly more interference on combat-related words (but not other emotional words) when compared with veterans without PTSD. The results suggested that the PTSD group successfully habituated to combat-related words, but at a delayed rate. This lends some support to the continued use of interventions such as exposure therapy, which rely on desensitisation or habituation effects, although habituation findings from studies using abstract tasks such as the MST may not be generaliseable to real-world threat stimuli.

In another recent study, Khanna et al. (2016) highlighted design flaws in many earlier studies using the MST. For instance, the negative affect conditions included longer, less common or more unusually spelled words, factors which could account for delayed reaction times. Khanna et al. (2016) used a highly-controlled word list to minimise the confounding effects of lexical features (such as word length and frequency of use), involving only monosyllabic words that were neutral, war-related or negative in nature (e.g. "tune", "bomb" or "tax). The findings demonstrated that only veterans with PTSD exhibited interference effects for combat-related stimuli. Thus, after controlling for design variables, interference effects on the MST were negated for veterans without PTSD.

Lastly, a study by Constans et al. (2014) aimed to investigate a controversial trend whereby combat veterans have been reported to seek psychological and financial support for PTSD symptoms at a rate that exceeds estimates for the prevalence of PTSD in the veteran population. This is a contentious issue, and both deliberate malingering and a 'cry for help' have been proposed as possible explanations. The authors recruited veterans without PTSD, veterans with PTSD with and without an "overreporting style". This was described as a tendency to exaggerate or elevate symptoms and was determined using a self-report measure that has been validated against a structured interview schedule. The MST was administered because it is very difficult to feign impaired performance (even when offered financial incentives). Given the difficulty in falsifying interference effects, it was also thought that if the two PTSD groups differed in MST performance, the task could be used as a means of improving diagnostic accuracy. The most notable finding was that an overreporting style augmented the MST effect in veterans with PTSD, suggesting that overreporting reflected overall distress. The notion that overreporting in this sample was associated with distress rather than deliberate malingering for financial gain was supported by the finding that both PTSD were equally likely to have made disability claims, regardless of overreporting style.

In summary, a number of studies have used selective interference on the MST as a measure of attentional bias and found group differences between veterans with and without PTSD. This interference effect appears to be strongest when words are directly related to combat or traumatic experiences as opposed to being generally negative in valence. The effect persists when various characteristics of the stimulus set are controlled for, such as word length and frequency of use. Although at a delayed rate, veterans with PTSD habituate on the MST, which may further substantiate interventions such as exposure therapy (although the extent to which the findings of experimental studies generalise to real-world settings is unclear). Despite reasonably convincing research evidence indicating that the MST differentiates between military personnel with and without PTSD, the task has some limitations. Firstly, it is a gross measure that does not necessarily disentangle the mechanisms underpinning attentional bias. For example, the interference of emotionally salient words could reflect enhanced ability to detect threat, reduced cognitive resource, or difficulty shifting focus back to a task once threat has captured attention. The MST is also restricted by only including visually presented words. This precludes the examination of attentional bias in other sensory modalities (e.g. attending to threatening words or sounds, such as gunshots), or using richer stimulus sets (e.g. images, scenes, faces, videos etc.). Lastly, the MST has limited diagnostic utility and has not been used to manipulate or reduce attentional bias or to ameliorate PTSD symptoms. More recent research studies using the dot probe paradigm have addressed some of these limitations, and this literature will be discussed below.

3.3.2.2 Attentional bias and the dot probe paradigm

As described in the introduction, the dot probe paradigm involves a target appearing on a screen in the location where one of two stimuli (threatening or non-threatening) was previously presented. Whilst research investigating attentional bias using the MST has typically found interference effects for trauma-words, studies using the dot probe task have yielded mixed findings, with some indicating that PTSD in the general population is associated with attentional bias towards threat and others suggesting bias away from threat (e.g. Constans, 2005). In the current review, the search strategy returned three studies using the task within military populations, and a further three studies that used the task as part of a training programme. None of these studies found a clear-cut relationship between PTSD symptomatology and performance on the dot probe task. For instance, Sipos et al. (2014) examined dot probe performance using happy, neutral and angry faces as stimuli and found that the association between attentional bias and PTSD symptoms depended on the level of combat exposure; those with higher PTSD symptoms were slower to respond to targets in

threat locations (indicating bias away from threat) but only in the high combat exposure group.

In another study included in the current review, Schafer et al. (2016) posited that a static measure of attentional bias is overly simplistic and does not account for the dynamic, multi-stage nature of threat-processing. The authors suggested that it is not simply attentional bias towards or away from threat, but rather an overall dysregulation in the attentional system that makes it no longer adaptive in people with PTSD. They outline the case for multiple attentional stages in PTSD (hypervigilance, maintained attention, disengagement, strategic avoidance, further hypervigilance etc.). These stages would indicate attentional peaks (towards threat) and troughs (away from threat) that are more extreme in people with PTSD. Thus, averaging across multiple trials without accounting for within-participant temporal variability was proposed as a possible explanation for mixed findings in the literature. In order to investigate this, Schafer et al. (2016) administered a version of the dot probe task (also using emotional faces as stimuli) to German soldiers pre- and post- deployment to Afghanistan. They calculated both traditional mean latency scores and trial by trial analyses in order to compute both static and dynamic measures of attentional bias. They found that separating attentional bias into components of towards, away and a temporal variability metric predicted PTSD symptoms post-deployment as a function of traumatic experiences, whereas traditional aggregate mean bias scores did not. Interestingly, the findings held true for all emotionally arousing stimuli (regardless of valence), which led the authors to cautiously imply a link between emotional dysregulation and attentional dysregulation. Swick and Ashley (2017) also investigated attentional bias variability (rather than static bias towards or away from threat) by comparing veterans with and without PTSD on a version of the dot probe task using neutral and emotional word stimuli; they found that participants with PTSD showed greater fluctuations in attentional bias than controls.

Taken together, conflicting studies that have drawn different conclusions about the association between PTSD and attentional responses to threat may be reconciled by an account of attentional bias that emphasises dynamic rather than static processes and greater within-participant variability. Moreover, this explanation may more accurately represent symptom clusters in PTSD. Avoidance symptoms may be understood in terms of attentional bias away from threat, whereas hypervigilance symptoms may be associated with excessive focus towards threat. Acknowledging that the military personnel with PTSD in the current

studies may have fluctuated between both extremes of attention allocation is consistent with both symptom clusters.

One of the most promising aspects of research using the dot probe paradigm in the current review is the development of interventions that can both improve attention allocation and target PTSD symptoms. Khanna et al. (2016) wanted to determine whether systematically training attention away from threat (attentional bias modification; ABM) or improving flexibility and attentional control (attentional control training; ACT) is more effective, and thus administered each type of training programme to two respective groups of veterans with PTSD. The results suggested both types of training improved performance on the MST and ameliorated PTSD symptoms, with attentional control showing stronger effects than systematic attentional training away from threat.

Two further studies in the current review investigated whether attentional training (using the dot probe task) could be used as a preventative measure for military personnel pre-deployment, to reduce the likelihood of developing PTSD post-deployment, as opposed to a treatment for PTSD. Wald et al. (2016) randomly allocated 719 soldiers to one of four conditions: high-dose (eight sessions) ABM, low-dose ABM (four sessions), low dose ACT and no intervention. They found that only low-dose ABM produced significantly lower levels of post-deployment PTSD, and that these effects were sustained at follow-up. Given previous findings that the relationship between PTSD and attentional bias may be exacerbated by the degree of combat exposure (e.g. Sipos et al., 2014), Wald et al. (2017) conducted a further study utilising attention training as a preventative measure and found that ABM attenuated the relationship between traumatic exposure and stress-related symptoms (although it is worth noting that only a modest percentage of stress-related variance was accounted for by ABM).

In summary, recent studies have investigated attentional bias in military personnel with and without PTSD using the dot probe paradigm. The main contribution of this research has been to measure attentional bias with a broader range of stimuli and to highlight the dynamic attentional processes involved in responding to threat. Lastly, studies have used the dot probe task as part of attentional training programmes, and these show some early promise as a preventative measure as well as a method of improving attentional bias and ameliorating PTSD symptoms.

3.3.2.3 Other paradigms used to investigate attentional bias in military PTSD

The final four studies relating to attentional bias and military PTSD in the current systematic review have used alternative paradigms to MST and the dot probe task. Firstly, Pineles et al. (2007) highlighted that these tasks may not be pure measures of attentional bias, since interference could instead reflect other executive processes such as retrieval or response selection rather than difficulties specifically with the input stage of information processing. Moreover, these tasks cannot draw firm conclusions as to whether group differences are attributable to facilitated detection (greater ease finding threat-related stimuli) or interference (difficulty disengaging from threat stimuli). The authors instead emphasised the usefulness of visual search tasks, where a target stimulus is buried within an array of distractors and participants are required to detect the target. The ability to detect threat stimuli more quickly amongst neutral distractors is an example of facilitated detection, whereas detecting neutral stimuli more slowly amongst threat vs. neutral distractors is an example of interference. In their study, veterans high vs. low in PTSD symptoms engaged in a visual search task, whereby they detected the odd word out amongst distractors (by determining whether the target was a word or non-word) in either a facilitation or interference condition. Results found evidence for interference but not facilitation in the high vs. low PTSD groups. These findings were further supported by a second study (Armstrong et al., 2013) in which combat veterans with and without PTSD and nonveteran controls were presented with pairs of faces (one neutral, the other either happy, disgusted or fearful). Eye-tracking technology was used to assess both orienting bias (the proportion of trials in which participants initially focused on the emotional vs. neutral face, reflecting facilitated detection) and maintenance bias (the proportion of viewing time spent on emotional vs. neutral faces, reflecting difficulty disengaging). As with Pineles et al. (2007), the results indicated that participants with PTSD differed from controls with respect to difficulty disengaging but not facilitated detection. Thus, only veterans with PTSD maintained attention longer on negative vs. happy or neutral emotional faces and there were no group differences in orientation to emotional faces.

By differentiating between interference and facilitation, the studies conducted by Pineles et al. (2007) and Armstrong et al. (2013) helpfully illuminate different subcomponents of attentional bias. However, both these studies focus on the temporal aspects (i.e. faster reaction time; longer duration spent engaging) as opposed to accuracy. In a third study, Olatunji et al. (2013) compared veterans with and without PTSD and nonveteran controls on a task in which images (combat, neutral, disgust and pleasant) were rapidly presented. Target images of each type were rotated either to the left or right; participants were required

to indicate whether or not a rotated image had been presented (detection) and to indicate which direction it was rotated in (accuracy). Combat veterans with PTSD had impaired accuracy relative to both control groups, but only when responding to target images following combat-related distractors. This provides further evidence for PTSD characterised by difficulty disengaging from threat.

Rather than measuring attentional bias directly, the final study of this bias in the current review aimed to investigate whether the strategies people use in response to threatening stimuli might mediate the relationship between interference effects and PTSD. Wisco et al. (2013) highlighted research suggesting that deliberate suppression or avoidance may be maladaptive strategies that ultimately perpetuate PTSD symptoms, whereas approach-based strategies such as reappraising thoughts or asking for support are more helpful (e.g. Litman, 2006). They proposed that maladaptive attempts to control unwanted threat-relevant thoughts may account for the relationship between difficulty withdrawing attention from threat and PTSD symptom severity. Thought suppression, worry and lack of social control were thought to be particularly maladaptive thought-control strategies that had been studied in relation to PTSD directly, but their relationship to attentional bias had been neglected. Thus, Wisco et al. (2013) administered measures of PTSD, and thought-control strategies to combat veterans. Participants also completed a visual search task as a measure of attentional interference. Mediational models were used to assess the relationships between variables. The findings suggested that thought control strategies fully mediated the relationship between attentional interference and PTSD symptoms, and that thought suppression and worry better account for the relationship between interference and PTSD than social control. Difficulty withdrawing attention from threat (as measured by a visual search task) was related to greater use of thought suppression and worry. Whilst most attentional bias research has emphasised bottom-up, implicit processes (such as reaction times) in PTSD, these findings may offer very preliminary evidence in relation to the role of top-down, thought-control strategies. However, further research is needed to examine this further.

Taken together, in the current review, the majority of the 21 studies focusing on cognitive bias in military PTSD were focused on attentional bias. Earlier studies involved the modified Stroop task and consistently found an interference effect for trauma-related words. Later studies involved the dot probe task; several of these concluded that attentional responses to threat can be conceptualised as a dynamic process involving both bias towards and away from threat, depending on the stage of processing. These studies revealed that military

personnel with PTSD had greater fluctuations in attentional bias than those without PTSD. Lastly, studies using visual search tasks and eye-tracking have suggested that attentional bias in PTSD is better characterised by interference effects, whereby people struggle to disengage from threat, than by facilitation effects, whereby people show enhanced ability to detect threat. There is also some preliminary evidence to suggest that the relationship between attentional bias and PTSD symptoms may be mediated by unhelpful cognitive strategies such as thought suppression and worry.

3.3.3 Research relating to judgment biases in military PTSD

Subjective risk bias (the tendency to perceive the future as threatening) and interpretation bias (the tendency to perceive current, ambiguous situations as threatening) are biases in judgment that have been implicated in PTSD (Constans, 2005), but there has historically been very little evidence examining this directly. It was therefore unsurprising that the current review was unable to unearth studies examining the relationship between judgment biases and PTSD in specifically military populations. To date, no studies appear to have examined subjective risk bias in military personnel with and without PTSD. Only one study has examined interpretation bias in this population. Kimble et al. (2002) employed a sentence completion task to examine interpretation bias in veterans with and without PTSD. The authors chose this task for its simplicity and adaptability, and because unlike tasks such as the MST, sentence completion permits examination of more volitional, explicit processes. Participants were presented with incomplete sentences where multiple endings were possible and asked to generate endings as quickly as possible. Veterans with PTSD produced significantly more military endings than non-military endings, regardless of combat exposure, which the authors argued was indicative of the relatively spontaneous accessibility of trauma information.

Given the limited research, it is unclear whether negative or trauma-related interpretations are more readily activated or whether it is more difficult to suppress them (paralleling the facilitated detection vs. interference distinction in the attentional bias literature). It is also unclear whether any group differences would emerge in relation to alternative negative, non-military stimuli. Nevertheless, there appears to be plenty of scope for future research involving more varied or dynamic stimuli (such as sentences, scenarios, scenes, video clips or sounds). Recommendations for further research will be discussed in greater detail later.

3.3.4 Quality assessment

A subset of domains from a quality assessment tool (QATQ) and a research integrity checklist (RDFC) was selected for the purpose of this review (see Appendix). Each study included for qualitative synthesis was assigned a quality score on the basis of these domains; these are included in Table 3.2. 20% of the total studies were rated by a second assessor; interrater reliability was at 91.67%, with disagreements resolved through discussion. Each domain will now be discussed briefly.

3.3.4.1 Selection bias (QATQ)

Most studies in the current review were awarded a score of 'moderate'. This is because they primarily recruited participants from specialist veterans' services or from clinics. Only two studies were deemed 'strong' on this basis since they recruited from an entire battalion or region, and there therefore not sampled from a patient population. Three studies were deemed to be 'weak', since they only recruited via self-referral, or did not describe their selection methods. Despite these mixed results, it should be noted that the present review deliberately focuses on a very specific, minority population that may not necessarily represent the general population and lower quality ratings in this domain may therefore reflect the inevitable challenge of recruiting a minority group.

3.3.4.2 Confounders (QATQ)

Most studies reviewed here (15/21) had controlled for their confounders (e.g. age, gender, ethnicity, education level etc.) and were thus awarded a 'strong' score. This was done either at recruitment (for example, only recruiting men since this is an accurate reflection of the military population with direct combat experience), through matching, or in the analysis (for example, including potentially confounding variables as covariates). One study had controlled for some confounding variables, but not others, and was scored as 'moderate'. Five studies were deemed 'weak' on this domain since they had either failed to account for confounding variables in any way or had not disclosed potential confounds (e.g. failing to report any demographic information).

3.3.4.3 Data collection (QATQ)

This domain pertains to the reliability and validity of measures used in the studies reviewed. One study in the current review had poor reliability on one of its measures and was therefore scored as 'moderate' on this domain. However, the remaining 20 studies were scored as 'strong' since their tools were both reliable and valid. Whilst some studies did not explicitly

describe validity and reliability, PTSD is a commonly researched area with widely used tools (e.g. PTSD Checklist; PCL); validity and reliability had therefore been reported elsewhere.

3.3.4.4 Hypotheses (RDFC)

In the current review, three studies were scored as 'moderate' and one as 'weak'; the remainder were scored as 'strong' since there were clearly described hypotheses, including an expected direction of effect. However, it is important to note that this checklist is primarily used by reviewers responding to pre-registered reports and it is therefore difficult to rule out whether hypotheses were actually specified prior to data collection.

3.3.4.5 Variables (RDFC)

All but one study were rated as 'strong' on this domain. This was they were relatively parsimonious in their design; they did not include multiple independent variables or measure the same variables in multiple different ways. The one exception was due to an excessively complex experimental design involving multiple manipulations of independent variables with multiple levels, which may have carried an inflated risk of Type I error. As stated above, it is of course difficult to exclude the possibility that additional, non-significant variables were dropped after the analysis.

3.3.4.6 Power (RDFC)

No study in the current review was given a 'strong' score for this domain, since non described a power-analysis or explicitly discussed a rationale for choosing the sample size. Five studies were rated as 'weak' since they were underpowered (Cohen, 1992) and had not raised this as a limitation of the research. The remaining 16 studies either had broadly appropriate sample sizes or they had clearly discussed the limitations of their sample size.

4. DISCUSSION

4.1 OVERVIEW OF STUDIES

The current report provides an up-to-date review of research articles examining cognitive biases in military personnel with and without PTSD. In line with previous research, the studies included in this review emphasise the role of three biases in particular: memory bias, attentional bias and judgment bias. The findings have been discussed above and broadly indicate that in comparison with military controls, military personnel with PTSD have a propensity to be overgeneral when describing autobiographical memories, they tend to find disengaging from threatening stimuli more challenging, they show greater fluctuation between bias towards and away from threat and they are likely to draw trauma-relevant, threatening conclusions when presented with ambiguous information. The relevance for specifically military populations, methodological limitations, recommendations for future research and implications for clinical practice will now be briefly discussed.

4.2 IMPLICATIONS FOR MILITARY PTSD

As described earlier, there are differences in how PTSD manifests linked to distinct sources of trauma. For military personnel with PTSD, traumatic events may have taken place during prolonged periods of stress in comparison with other, non-military events (such as road traffic accidents or assaults). There is also evidence to suggest that military personnel, particularly those occupying a combat role, are at increased risk of developing PTSD (Fear et al., 2010), their symptoms may be more severe (e.g. Brinker et al., 2007), and they may experience difficulties in relation to identity, social role and adjustment when returning to civilian life (e.g. Brewin et al., 2011). How do the current studies elucidate military-specific aspects of PTSD?

Increased responding to even minor threat cues has been conceptualised as serving an adaptive function in the context of war (Wald et al., 2016). The literature suggests that one component of attentional bias is facilitated threat detection, whereby people are able to notice danger more quickly (e.g. Pineles et al., 2007). It could be argued that a heuristic that enables people to notice potential threats in the environment more readily serves an adaptive function: protecting them from harm. In contrast, in the current studies, those with PTSD did not demonstrate enhanced detection; they instead found disengaging from threat more difficult. This could be considered a maladaptive attentional bias. Sipos et al. (2014) also found that group differences in attentional bias only emerged for those with higher levels of

combat exposure, which suggests that cognitive biases may arise from a complex interplay between PTSD symptoms and military experiences. Comparing military personnel with PTSD against those without PTSD and also civilian controls may thus be a helpful way to differentiate between maladaptive attention to threat as part of general PTSD symptomatology and a potentially more adaptive attentional bias linked to combat exposure. However, only three studies in the current review did so, and these did not find evidence that the military control groups had enhanced threat detection relative to civilian controls. These findings may indicate that enduring attentional bias is specific to PTSD symptomatology rather than combat exposure. It may of course be the case that some enhanced detection of threat exists for military controls whilst at war, but this attenuates after returning home. This would evidently be adaptive since it describes attention allocation fluctuating to match the objective danger present in the environment.

A final finding from the current review that pertains specifically to military PTSD was a post-hoc observation in one study that wearing war regalia exacerbated overgeneral autobiographical memory (McNally et al., 1995). It is worth noting that PTSD is characterised by avoidance of traumatic reminders; wearing war regalia could potentially indicate that symptoms are less severe, although this does not account for the exacerbation of overgeneral memory bias (which has been previously linked with PTSD; Wessel et al., 2002). One simple explanation that does account for this is that deliberately wearing reminders of war may makes war-related trauma memories more easily accessible. However, the causal direction is unclear; given that military PTSD is linked with loss of identity, role change and adjustment difficulties, it is possible that those with symptoms are more likely to continue to wear war regalia to connect with their military identity.

Bringing together the conclusions from the studies in the current review offers some tentative early hypotheses about the role of cognitive biases in military PTSD. However, surprisingly few research articles discussed the specific relevance of recruiting military participants and there is considerable scope for this to be examined further in future research.

4.3 LIMITATIONS

One significant limitation of the studies reviewed was the lack of ecological validity. With the exception of two studies examining autobiographical memory, the research described typically used abstract experimental paradigms such as the modified Stroop and dot probe tasks. The research described in this review provides a significant contribution towards

delineating the nature of cognitive biases in military PTSD. However, there is a paucity of work using ecologically valid tasks that reflect naturalistic settings that present commonplace demands. In reality, military personnel (both currently and previously serving) are frequently required to make judgments based on what they experience in the world around them and tasks that involve lexical decision-making, sentence completion, forced-choice responses or eye-tracking may not adequately capture these demands. This limitation applies to not only experimental tasks investigating cognitive biases in military PTSD but also to training programmes designed to reduce bias and, by extension, to ameliorate PTSD symptoms. A subset of the studies described in the current review involved bias modification training programmes and reported promising results, but these sorts of cognitive paradigms are unlikely to transfer to real-world settings.

A second methodological limitation was the task validity; the extent to which the paradigms were genuinely tapping into distinct cognitive constructs is unclear. For example, in studies of memory bias, implicit and explicit memory were differentiated only on the basis of whether or not a clear instruction to recall previously presented words was given. Moreover, small differences in reaction times may be sensitive to subtle variation in factors such as word length, frequency of use or degree of emotionality. Whilst some of the more recent studies reviewed here have attempted to address this limitation (e.g. Khanna et al., 2016), the majority do not attempt to do so.

Finally, it is important to consider the limitations of the current systematic review. The first pertains to the quality assessment process. Many quality assessment tools are designed to evaluate RCTs and other studies exploring the efficacy of treatment and few exist to evaluate more basic, mechanistic experimental research. This meant that a small subset of domains on the QATQ was relevant for the included studies. The RDFC offered some additional domains, but (as described elsewhere) it is difficult to draw firm conclusions about research practices post-hoc. It should also be noted that only a subset of articles was rated by a second researcher. It would have been ideal to double-rate all included articles, although it is reassuring that there was a high degree of agreement between raters. Finally, the initial retrieval of studies was carried out by one researcher. In future reviews it might be helpful and reduce bias if a second researcher confirmed the decision to include or exclude studies, especially for studies where the decision was not clear-cut.

4.4 RECOMMENDATIONS FOR FUTURE RESEARCH

4.4.1 Research priorities

A number of potential recommendations emerged from the studies reviewed. Firstly, as discussed above, future studies should consider including military and civilian control groups, and ideally also people with PTSD stemming from non-military sources. Secondly, more ecologically valid measures of cognitive bias should be developed. This might involve the use of a broader range of stimuli that more accurately reflect the rich, detailed and dynamic environments in which people with PTSD originally experienced traumatic events, including vignettes and audio/video clips. Future tasks could also involve more everyday types of threat, since it is unclear whether group differences are diminished when combat-specific reminders are removed. Thirdly, as described above, studies of cognitive bias in military PTSD have predominantly focused on attentional bias. Few have also explored memory bias. However, virtually no studies have been conducted examining judgment biases such as subjective risk bias and interpretation bias. Given that PTSD, along with other anxiety disorders, is heavily associated with misinterpretation of events, it is surprising that so few studies have explored this area. Although Kimble et al. (2002) found evidence for interpretation bias using a word stem completion task, it is unclear whether this truly reflects threatening interpretations of ambiguous information or vigilance to threat, as opposed to stronger associative priming for combat-related words or rumination about war in those with PTSD. Therefore, there is ample scope for future research to focus on judgment biases in military PTSD.

Lastly, it is worth noting that participants in 86% of the studies included in the current review were members of the US Armed Forces. None involved members of the British armed forces. Studies of recent conflicts estimate that PTSD is less prevalent amongst British versus US veterans (Richardson et al., 2010). These differences are thought to be partly attributable to sampling, measurement and diagnostic issues, but sociological and cultural factors should also not be neglected (Richardson et al., 2010). It is therefore imperative that future research into the relationship between cognitive biases and military PTSD involves members of the British armed forces, as well as armed forces from other countries.

4.4.2 Recommendations for quality improvement

The studies in the current review generally scored reasonably well on the QATQ domains. However, one key recommendation that emerged from the quality assessment was the importance of properly managing confounding variables (such as matching, stratification, or

planned analysis), since studies that lost points on the QATQ domains tended to lack a strategy for doing so. The RDFC tool was selected as a means of assessing the veracity of decisions made by researchers that can affect the quality of research. One clear finding to emerge from this aspect of the quality assessment was that a power analysis or justification for sample size was lacking across all studies. It is recommended that this is included in future studies, since lack of statistical power is likely to create bias and thus inflate the likelihood of a type I error (see Wicherts et al., 2016 for a review). With the exception of this recommendation, quality assessment using the RDFC presented a challenge. Although the checklist describes a number of excellent ideals for research integrity, it is very difficult to ascertain whether these standards have been met after a paper has been published. As described above, hypotheses could be specified after the research findings are known, or multiple additional variables could be dropped prior to publication, alongside a host of other 'questionable research practices' (e.g. Fielder & Schwarz, 2016). It should be recognised that questions about research integrity have in part arisen as part of a systemic failure; only a small proportion of research articles submitted to peer-reviewed journals result in publication, and there is an overwhelming appetite for significant findings. One tentative recommendation to improve quality of future studies is to pre-register studies prior to beginning data collection, since this could have a role in reducing questionable research practices (Chambers et al., 2014). It is also recommended that further quality assessment tools that specifically evaluate the quality of more experimental research are developed for future systematic reviews.

4.5 IMPLICATIONS FOR CLINICAL PRACTICE

The focus of the current review was to examine the literature relating to cognitive biases in military personnel with PTSD. The studies yielded from the search involved military personnel with and without PTSD completing various experimental tasks. Given the mechanistic nature of the research reviewed, there are few direct recommendations for clinical practice. However, the findings might have some tentative clinical implications, which will now be briefly discussed.

The key findings from the current review could inform existing packages of support. Most interventions for PTSD in the general population include an early psychoeducation component, whereby individuals are encouraged to learn about the mechanisms underpinning the development and maintenance of their symptoms. For military personnel, a variety of post-operational stress management programmes have been developed as a means of identifying those at risk of developing mental health problems, reducing stigma

and promoting successful reintegration into civilian life (e.g. Greenberg et al., 2010; Frappell-Cooke et al., 2010; Fertout et al., 2011). The findings from the current review might add to these various programmes of support. Specifically, findings suggesting that it is common for people with PTSD to pay excessive attention to threat, to struggle to disengage from threatening stimuli and to draw threatening conclusions when a situation is ambiguous might help to normalise symptoms and reduce stigma, distress and confusion. There were also findings suggesting that military personnel with PTSD were able to habituate to threat-stimuli (albeit at a delayed rate). This is consistent with the effectiveness of interventions such as exposure therapy, thus lending further support to current-evidence-based treatments.

Finally, a tentative clinical implication of the current review findings pertains to the use of experimental paradigms (e.g. dot-probe) as a training programme, with evidence from a small number of studies suggesting that training was associated with a reduction in both attentional bias and PTSD symptoms. Two types of training programme have been used: attentional bias modification (ABM) and attentional control training (ACT). Arguably, ACT has greater theoretical merit; the literature suggests that attentional bias is characterised by fluctuations towards and away from threat, which suggests an intervention that promotes attentional control is superior to one that consistently trains attention away from threat. However, both interventions have led to improvements. In one study that measured attentional bias before and after deployment, ACT, a low dose of ABM and a high dose of ABM were directly contrasted in training sessions that took place *prior* to deployment. The low-dose (i.e. fewer sessions) of ABM was most successful (Wald et al., 2016). The reasons for this are not clear. One possibility is that ACT is more effective after symptoms have developed and ABM as a preventative measure. Another possibility is that the low-dose was more acceptable to patients than a high dose; repeatedly responding to a target dot on the dot probe task may have led to difficulties sustaining interest and engagement across eight sessions. This is supported by the fact that many of the studies investigating the effects of attentional bias training programmes led to relatively high drop-out rates. Given the ambiguity in the literature, further research to clarify the optimal training programme is needed. Moreover, there was no follow-up in these studies to indicate that the symptom-reducing effects of training were enduring.

In summary, although further research is needed before any firm recommendations for clinical practice can be made, the findings from the current review could be used to support or expand upon existing treatments, and to highlight the potential benefits of training

programmes as a means of reducing both cognitive bias and PTSD symptoms. In the future, it will be important to develop a broader range of PTSD intervention tools, based on the cognitive bias research, that are both feasible and acceptable to military personnel pre and post deployment.

4.6 CONCLUDING COMMENTS

In the current review, examining studies that purport to measure differences in cognitive bias between military personnel with and without PTSD provided further evidence for the role of biases in memory, attention and judgment in those with the disorder. The review also helped to elucidate the extent to which PTSD symptoms versus combat exposure play a role, although it highlighted that further work is needed in this area. Some of the mechanisms underpinning these biases, such as threat detection and interference effects, were explored, and the implications for treatment were discussed. However, this review also revealed significant limitations in the current literature, whereby tasks have high laboratory control but poor ecological validity, and there is a paucity of literature focusing on judgment biases.

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APPENDIX: QUALITY ASSESSMENT TOOL AND SCORING GUIDELINES

QATQ		
1. Selection bias	**Score (0-2):**	
Strong: participants are very likely to be representative of the target population and there is greater than 80% participation		2
Moderate: participants are at least somewhat likely to be representative of the target population and there is 60-79% participation (or the level of participation is unclear)		1
Weak: participants are unlikely to be representative of the target population **OR** participation is less than 60% **OR** neither selection nor level of participation is described		0
2. Confounders	**Score (0-2):**	
Strong: there were no important differences between groups **OR** 80% of relevant confounders were controlled for		2
Moderate: 60-79% of relevant confounders were controlled for		1
Weak: less than 60% of relevant confounders were controlled for **OR** control of confounders was not discussed		0
3. Data collection methods*	**Score (0-2):**	
Strong: the data collection tools have been shown to be valid and reliable		2
Moderate: the data collection tools have been shown to be valid but not reliable (or reliability is not described)		1
Weak: the data collection tools have not been shown to be valid **OR** both reliability and validity are not described		0
QATQ Total Score (/6):		

RDFC		
4. Hypotheses	**Score (0-2):**	
Strong: the study described clear hypotheses **AND** specified the direction of effect		2
Moderate: the study's hypotheses were described vaguely, without specifying the direction of effect		1
Weak: the study described purely explorative research, without stating any hypotheses		0
5. Variables	**Score (0-2):**	
Strong: Multiple independent variables were not manipulated **AND** the same dependent variables were not measured in several ways, minimising chances of Type I errors		2
Moderate: Multiple independent variables were manipulated **OR** the same dependent variables were measured in several ways, but analyses were adjusted accordingly (e.g. Bonferroni correction) **OR** this was discussed as a limitation		1
Weak: Multiple independent variables were manipulated **OR** the same dependent variables were measured in several ways, and this was not adjusted in the analysis or discussed as a limitation		0
6. Power	**Score (0-2):**	
Strong: A well-founded power analysis was conducted **OR** methods for choosing sample size were described		2
Moderate: A well-founded power analysis was not conducted and methods for choosing sample size were not described, but sample size is appropriate (as per Cohen, 1992) **OR** limitations of sample size are clearly discussed		1
Weak: A well-founded power analysis was not conducted and methods for choosing sample size were not described **AND** sample size is inappropriate (as per Cohen, 1992) **AND** the limitations are not discussed		0
RDFC Total Score (/6):		
QATQ+RDFC Total quality assessment score (/12):		

*As per the QATQ supplementary dictionary, reliability and validity can be reported in the study or in a separate study. For example, some standard assessment tools have known reliability and validity

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Sources:

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Empirical Research Project: Interpretations of Ambiguous Situations in Combat Veterans with and without PTSD

Supervisors: Professor Neil Greenberg & Dr Dominic Murphy

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Background: Post-traumatic Stress Disorder (PTSD) is a debilitating mental health disorder characterised by intrusive memories, avoidance of traumatic reminders, and hyperarousal in the aftermath of a traumatic event. Symptom profiles may vary depending on the nature and duration of the traumatic event. Deployed combat personnel often experience prolonged periods of stress and are thought to be at increased risk of PTSD. Their symptoms can also be more severe, chronic and treatment-resistant than in the general population. Interpretation bias describes a systematic tendency to judge ambiguous information to be negative or threatening in nature and is thought to be more common in people with PTSD. However, for combat personnel, interpreting ambiguous information as potentially threatening whilst deployed is highly adaptive and a helpful way to remain safe. The extent to which interpretation bias in combat personnel can be considered pathological, and linked with PTSD symptoms, rather than an inevitable aspect of the combat role is thus unclear.

Method: In order to investigate the above question, 20 combat veterans with PTSD, 22 veterans without PTSD and 20 civilians without PTSD completed the Bodily Sensations Interpretations Questionnaire (BSIQ). This task required participants to read brief scenarios describing ambiguous situations. Participants firstly generated their own explanations for the situation and were then presented with different possible explanations, one of which was negative, and both ranked and rated these explanations in terms of likelihood. In an extension of the original task, participants were also asked to imagine that the worst-case scenario was true and to make judgments about what the future would be like and about their ability to cope.

Results: The findings revealed that in comparison with both veteran and civilian controls, combat veterans with PTSD generated more negative explanations for ambiguous situations, judged negative interpretations to be more likely and felt less able to cope with the worst-case scenario. Veterans with versus without PTSD were also more likely to judge the worst-case scenario to have more severe and insurmountable consequences for the future, although they did not differ significantly from the civilian group in this regard. Lastly, the combat and civilian control groups did not differ in their responses, with one exception: combat veterans without PTSD rated their ability to cope as higher than did civilians without PTSD.

Conclusions: The current study comprised a number of novel aspects. Firstly, it investigated interpretation bias, which has been relatively understudied in comparison with other cognitive biases (such as attentional bias). Secondly, tasks commonly used to investigate cognitive bias offer a high level of experimental control but as a result tend to be abstract in nature; the current study used a task with relatively good ecological validity. Lastly, the current study expands understanding of specifically combat-related PTSD. The findings suggest that interpretation bias in combat-related PTSD is likely to be associated with PTSD symptoms rather than combat exposure. The findings also indicate that combat veterans without PTSD may be particularly resilient and able to cope with everyday adversity. The findings are discussed in relation to a prominent model of PTSD, and the potential implications for further research and for clinical practice are considered.

1. INTRODUCTION

1.1 OUTLINE OF INTRODUCTION

Post-Traumatic Stress Disorder (PTSD) is a debilitating mental health disorder characterised by intrusive symptoms, persistent avoidance, negative alterations in cognitions in mood and alterations in physiological arousal or reactivity following traumatic event (DSM-V; American Psychiatric Association, 2013). Combat veterans are at increased risk of developing PTSD, and the symptoms are often more severe than in the general population (Stevelink et al., 2018). In order to provide an overview of relevant literature and the rationale for the current study, the introduction will firstly present a historical perspective on emotional distress following trauma. It will then describe current diagnostic criteria, risk factors, assessment and treatment of PTSD. The merits of examining PTSD in combat personnel will then be discussed in detail, with specific reference to a cognitive model of PTSD. Lastly, the aims and hypotheses of the current study will be presented.

1.2 OVERVIEW OF PTSD

1.2.1 Historical perspectives on PTSD

Post-traumatic stress disorder (PTSD) is characterised by ongoing intrusive re-experiencing, avoidance, changes in cognition and mood (e.g. difficulties recalling the traumatic event, persistent negative emotional state) and hyperarousal in the aftermath of a traumatic event. Traumatic events are defined as directly experienced or witnessed exposure to actual or threatened death, serious injury, or sexual violence (American Psychiatric Association, 2013). The concept of PTSD largely has its roots in the experiences of military personnel, with physical and psychological manifestations of soldiers' emotional distress widely reported for centuries (Jones, 2013). These include psychosomatic symptoms such as palpitations and tremor, neurological symptoms (without apparent organic basis) such as confusion and fatigue, and affective symptoms such as low mood (Jones, 1995). Before the 20th century, clinical syndromes such as irritable heart, wind contusions, nostalgia and melancholia were used to describe these symptoms (Jones and Wessely, 2005). The concept of 'shell-shock' emerged after the first world-war, and pertained to a heterogenous set of complaints, including fatigue, poor sleep, nightmares, hyperarousal, and functional impairment (e.g. deficits in memory or sensory perception; paralysis). Attempts to treat shell-shock contributed to the gradual recognition of physiological and functional manifestations of

intense psychological distress, and to the rapid expansion of the field of military psychiatry (Jones and Wessely, 2005). Shell shock has thus been conceptualised as a precursor to PTSD (e.g. Crocq & Crocq, 2000).

PTSD was formally recognised as a mental health disorder in 1980, when it was included in the third edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM) following research into the difficulties experienced by Vietnam war veterans, Holocaust survivors, sexual trauma survivors and others (US Department of Veterans Affairs). This formed the foundation of much of our present-day understanding of PTSD.

1.2.2 Current conceptualisation of PTSD

1.2.2.1 Diagnostic criteria

The diagnostic criteria for PTSD as described in the most recent edition of DSM (DSM-V; American Psychiatric Association, 2013) are as follows:

- Exposure to actual or threatened death, serious injury or sexual violence (either directly or indirectly, for example by witnessing the event occur to others or by learning that the event was experienced by a loved one).
- Intrusive symptoms, such as recurrent, involuntary memories, flashbacks, nightmares, and intense or prolonged psychological or physiological distress triggered by reminders of the event.
- Persistent avoidance of stimuli associated with the traumatic event. This may involve avoiding internal reminders (such as memories, thoughts or feelings that relate to the event) and external reminders (such as people, places, conversations, activities etc. that are associated with the event).
- Negative alterations in cognitions and mood. These include: an inability to recall aspects of the traumatic event, exaggerated negative beliefs about oneself, others or the world, beliefs about the causes of the event that lead a person to blame themselves or other people, low mood and other negative emotional states (such as guilt or shame), diminished interest in enjoyable activities and feelings of estrangement or detachment from others.
- Alterations in physiological arousal or reactivity. This may involve increased irritability, anger or aggression, reckless or self-destructive behaviour, hypervigilance, exaggerated startle response, problems with concentration and sleep difficulties.

These difficulties must be present for a minimum of one month, cause significant distress and functional impairment, and must not be attributable to substance misuse or an alternative medical condition.

1.2.2.2 Risk Factors

In the UK, one in three people report having experienced at least one traumatic event (Mental Health Foundation). Many of these individuals are likely to experience PTSD-like symptoms, referred to as an 'acute stress response' for the first month (Royal College of Psychiatrists, 2015). However, these symptoms generally attenuate, with only a small proportion of trauma-survivors going on to develop PTSD (e.g. Greenberg et al., 2015).

A number of factors might increase the risk of developing PTSD. Early, pre-traumatic risk factors that are thought to be particularly relevant include a family history of mental disorder, early experience of trauma, negative parenting experiences and lower education (e.g. Shalev, 1996). However, risk factors pertaining to the peri and post-traumatic period are thought to have stronger effects than these pre-traumatic factors (Brewin et al., 2000). Aspects of the trauma period itself include trauma severity, perceived threat to life, negative emotional responses, and in particular, dissociation during the trauma (Ozer et al., 2003).With respect to post-traumatic risk factors, the number of life stressors faced by individuals (e.g. Brewin et al., 2000) and the availability and quality of social support (e.g. Harvey et al., 2011) are thought to be of importance.

1.2.2.3 Assessment

PTSD is assessed by clinicians using a combination of measures that map onto DSM diagnostic criteria. Self-report measures include the Impact of Event Scale (IES; Horrowitz et al., 1979), the Post-traumatic Diagnostic Scale (PDS; Foa et al., 1997), and the PTSD Checklist (PCL; Weathers & Ford 1996). These measures invite respondents to specify the frequency and/or severity of PTSD symptoms. Interview schedules include the Clinician Administered PTSD Scale (CAPS; Blake et al., 1995) and the PTSD Symptom Scale – Interview version (PSS-I; Foa et al., 1993). All these measures have good reliability and validity and are frequently used in both research and clinical contexts (National Collaborating Centre for Mental Health, 2005). The PCL is often used in military mental health research, since both military and civilian versions of the measure exist (US Department of Veterans Affairs).

1.2.2.4 Treatment

The evidence base (e.g. Cusack et al., 2016; NICE, 2018) supports two main approaches to the treatment of PTSD: trauma-focused cognitive behavioural therapy (TF-CBT) and eye movement desensitisation and reprocessing (EMDR). TF-CBT is an evidence-based approach that involves multiple components. Psychoeducation is provided to normalise PTSD symptoms and explain the rationale for the treatment approach. Behavioural aspects of TF-CBT may include both imaginal and in vivo exposure. Imaginal exposure entails confronting trauma memories by providing a detailed narrative account of the event(s) in chronological order whilst describing perceptions, thoughts and feelings experienced at the time of the trauma. This process is repeated until recounting the event no longer evokes high levels of distress and the trauma is experienced as a memory rather than a current threat. In vivo exposure involves confronting situations, people, places or objects that were previously avoided because they were associated with traumatic events or elicited strong emotional reactions. Repeated in vivo exposure enables people to realise that the feared situation no longer poses a threat. Cognitive aspects of TF-CBT involve identifying negative cognitions or beliefs about the self, other people or the world that are associated with traumatic events (e.g. "it's my fault that it happened", "other people will try and hurt me" or "the world is fundamentally dangerous). These cognitions can lead to the overestimation of threat. Trauma-related cognitions are gently challenged, for example by exploring evidence for and against and by testing out predictions about the inevitability of danger.

EMDR shares a number of features with TF-CBT. EMDR also involves imaginal exposure, desensitisation and challenging negative cognitions, but combines these processes with 'rhythmic bilateral physical stimulation' (for example, moving one's eyes from side to side, tapping both hands or listening to tonal sounds; Shapiro, 1989). The proposed function of this stimulation is to distance the individual from their traumatic memories by reinforcing the notion that the memory is in the past and incongruent with current experiences (e.g. Brewin, 2003). Despite the evidence in support of EMDR (e.g. Cusack et al., 2016) and its designation as a distinct treatment approach involving specialised training, the degree of overlap with TF-CBT has led reviews to conclude that the effectiveness is mostly likely due to common treatment components rather than bilateral stimulation (e.g. Davidson & Parker, 2001; National Collaborating Centre for Mental Health, 2005). However, a more recent systematic review concluded that bilateral stimulation may reduce distress associated with traumatic memories, which in turn may make various PTSD treatment components more

tolerable, and therefore that the use of EMDR over TF-CBT should be a matter of service-user choice and clinician expertise (Jeffries & Davis, 2013).

Another approach to the treatment of PTSD is Narrative Exposure Therapy (NET). This is a newer intervention that may be offered as a variant of TF-CBT (NICE, 2018). It was developed as a means of supporting victims of organised violence and has been used extensively with asylum seekers and refugees in both high-income and low-income countries (Robjant & Fazel, 2010). NET entails people developing a chronological narrative of their entire life, concentrating in great detail on traumatic events (similar to imaginal exposure in traditional TF-CBT) but also incorporating more positive memories. This approach is designed to process and contextualise traumatic events, addressing core symptoms of PTSD, whilst simultaneously cultivating a sense of personal identity and highlighting strengths and resources.

The choice of which treatment approach to adopt depends in part on the type of traumatic event. This is because people who have PTSD stemming from different sources of trauma may present with distinct symptom profiles. For instance, people who have experienced natural disasters may be most likely to view the world as unjust and unpredictable (e.g. Garcia et al., 2015) and may be facing severe and enduring social and economic consequences (such as the loss of one's home). Alternatively, survivors of an assault may have strongly-held beliefs about others as dangerous and untrustworthy or about themselves as weak or defective in some way (e.g. Ali et al., 2002). PTSD symptoms for assault-survivors can also vary depending on the type and severity of assault (Hembree et al., 2004). In general, PTSD is more likely to arise from intentional acts of interpersonal violence, especially combat and sexual assault, than from accidents or natural disasters (e.g. Creamer et al., 2001).

PTSD presentation may also vary depending on the number of traumas; this also has implications for treatment. For instance, one-off events are typically treated with TF-CBT (NICE, 2018). However, for people who have experienced multiple traumatic events over a prolonged duration, the guidance is less clear-cut. As described above, there is emerging evidence for NET for people with this sort of trauma history (Robjant & Fazel, 2010) but there are no formal recommendations regarding treatment. The most recent version of the International Statistical Classification of Diseases and Related Health Problems (ICD-11; World Health Organisation, 2018) has included 'Complex PTSD' (CPTSD) as a diagnostic category for the first time. They define this as "a disorder that may develop following

exposure to an event or series of events of an extremely threatening or horrific nature, most commonly prolonged or repetitive events from which escape is difficult or impossible (e.g., torture, slavery, genocide campaigns, prolonged domestic violence, repeated childhood sexual or physical abuse). All diagnostic requirements for PTSD are met. In addition, Complex PTSD is characterised by severe and persistent 1) problems in affect regulation; 2) beliefs about oneself as diminished, defeated or worthless, accompanied by feelings of shame, guilt or failure related to the traumatic event; and 3) difficulties in sustaining relationships and in feeling close to others. These symptoms cause significant impairment in personal, family, social, educational, occupational or other important areas of functioning" (World Health Organisation, 2018). The recognition of complex PTSD as a distinct disorder with a unique symptom profile may help to promote research in this area and ultimately to develop evidence-based recommendations for treatment. Given that CPTSD is most common following chronic, repeated interpersonal trauma (e.g. Forbes et al., 2012), it may be a relevant concept when considering PTSD in military personnel.

Taken together, there is substantial heterogeneity within the concept of PTSD, depending on type and number of traumatic events, duration, and consequences for emotion regulation, sense of identity and relationships with others. It is therefore important to ensure that assessment and interventions are suitably matched to specific trauma type.

1.3 COMBAT-RELATED PTSD

1.3.1 Focus on combat exposure within military personnel

The armed forces are a highly heterogenous group. The demands on people and the risks inherent in different sectors (e.g. Royal Navy, Army and Royal Air Force) and for different roles (e.g. technicians, infantry soldiers, army nurses) are unlikely to be comparable and there is a danger of oversimplification (DeVries & Wijnans, 2013). This heterogeneity in roles and responsibilities translates into different rates of PTSD; the prevalence of PTSD across the armed forces is estimated to be 4%, but rates increase to 7% when considering only those who occupy a combat role (Fear et al., 2010). Recent research suggests that the prevalence of PTSD is increasing (Stevelink et al., 2018) and that combat exposure is a specific risk factor (Fertout et al., 2011; Xue et al., 2015). Given the strength of the association between combat exposure and PTSD, the remainder of this literature review and the current research pertains specifically to combat personnel.

1.3.2 Combat-related risk factors

Why might combat personnel be particularly at risk? For any deployed military personnel, austere living conditions, prolonged periods of separation from one's family and/or civilian lifestyle and the number and length of deployments are associated with an increased risk of PTSD (Fertout et al., 2011; Xue et al., 2015). With respect to combat personnel, they are subject to these general military-wide risk factors, but their role means that they are also more likely to encounter situations involving threat of death or serious injury that are by definition considered to be traumatic events. In the context of armed combat, discharging a weapon, experiencing a subjective sense of threat or 'mental defeat' (whereby people mentally 'give up' during trauma; Wilker et al., 2017) are all thought to increase the risk of developing PTSD (Xue et al., 2015; Alvarez-Conrad et al., 2001; Ehlers et al., 2000). Lastly, combat veterans are at risk of encountering potentially morally injurious experiences (PMIEs; Williamson et al., 2018). Moral injury refers to strong emotional responses (such as guilt, anger or disgust; Farnsworth et al., 2014) experienced by people who have perpetrated, witnessed, learned about or failed to prevent "acts that transgress deeply held moral beliefs and expectations" (Litz et al., 2009). Although further research is needed, recent evidence has drawn a tentative association between exposure to PMIEs and mental health disorders (Williamson et al., 2018).

1.3.3 PTSD presentation in combat personnel

How does PTSD manifest in combat veterans? In addition to increased risk and prevalence of PTSD, this population is also thought to experience more severe symptoms in comparison with civilians exposed to traumatic events of a similar magnitude (e.g. Brinker et al., 2007). For instance, research studies have found that people hospitalised due to combat are more likely to report re-experiencing and hyperarousal than those hospitalised for other traumatic events (Gaylord et al., 2004). Hyperarousal in particular is a prominent characteristic of PTSD, regardless of source of trauma, occurring in 70% of cases (Weston, 2014). Moreover, longitudinal research has found that hyperarousal may exacerbate other symptom clusters (such as re-experiencing), and stronger baseline hyperarousal following trauma has been linked with worse long-term outcomes (Schell et al., 2004). There is evidence to suggest that hyperarousal is especially relevant for combat-related PTSD, with combat veterans more likely to experience hyperarousal than people with PTSD stemming from other sources, including sexual abuse (Henigsberg et al., 2001). However, the relationship between combat-related PTSD and hyperarousal is complex. For instance, Kimble et al. (2013) found that although combat soldiers with PTSD had the greatest hypervigilance (and non-combat

soldiers without PTSD had the least), combat soldiers without PTSD demonstrated hypervigilance to a similar extent to non-combat soldiers with PTSD. This led the authors to conclude that hypervigilance is a likely consequence of combat exposure, regardless of the development of PTSD, and therefore should not be excessively pathologised in a military sample. This is because whilst hypervigilance could be considered maladaptive for people who have suffered a one-off trauma, warzones are inherently threatening, and soldiers are trained to attend to, detect, and respond appropriately to threats. Therefore, the relative contributions of PTSD vs. combat exposure to the experience of hyperarousal are unclear and further research is needed to disentangle these factors.

Another factor that differentiates combat personnel from other groups is treatment response: combat veterans take longer to seek help and have poorer treatment responses relative to both civilians and military personnel occupying a non-combat role (Murphy & Smith, 2018). There are many possible reasons for this; perceived barriers to seeking support include career concerns, worries about confidentiality, and not wishing to relive traumatic experiences. Even amongst those who do seek support, there is often significant complexity in presentation which can contribute to poor treatment response. For instance, one study found that 32% of those with PTSD met criteria for three other health outcomes (e.g. depression, anxiety, anger, or substance misuse; Murphy et al., 2017). However, stigma, concerns about clinicians' understanding of military culture, and the challenges of reintegration into civilian life have been highlighted as prominent reasons for poor outcomes in combat veterans with PTSD. These will now be considered in turn.

1.3.3.1 Stigma and attitudes to mental health

Challenges around stigma are of course not unique to the military, nor to PTSD; many civilian adults presenting with a range of mental health difficulties do not seek support (Adult Psychiatric Morbidity Survey, 2014). Nonetheless, it is important to consider the role of stigma in relation to combat-related PTSD. Significant numbers of UK combat personnel (77%) with mental health difficulties do not seek or receive treatment, often citing concerns about the possibility of stigmatisation (Hoge et al., 2004). These concerns about stigma may stem from pervasive attitudes towards mental health within military populations. For instance, stigma used to be actively encouraged, with the phrase "lack of moral fibre" deliberately being coined during the second world war in order to discourage disobedience or conscientious objection to war (Jones, 2006). Indeed, Wertsch (1991) argues that secrecy, stoicism and denial are embedded in military culture, and that personnel are motivated to

give the impression of being able to handle any stressor or burden; this results in a reluctance to acknowledge difficulties or seek help. Forbes et al. (2013) compared attitudes towards mental health in both military and civilian populations. Whilst both groups were generally accepting of mental health difficulties, participants in the military versus civilian group more likely to believe that causes were lack of self-discipline and will-power and less likely to endorse the view that mental health is on a par with physical health. Research has also found that military personnel (regardless of combat role) are less likely to attend their first psychology session as opposed to other medical appointments (Murphy & Busuttil, 2014), offering further evidence that physical illnesses are viewed as more legitimate than mental health difficulties within military populations.

1.3.3.2 Clinicians' understanding of military culture

The armed forces operate within distinct set of laws, norms, traditions and values and provide its members with a shared cultural identity (e.g. Coll et al., 2010). It has been argued that any clinicians working with military personnel must demonstrate an understanding of and respect for military culture (Hall, 2013). This is especially importance since there is a lack of trust in those providing mental health support (French et al., 2004), and military personnel tend to favour peer support (Murphy & Busuttil, 2014). How might a lack of understanding of military culture adversely affect engagement and treatment response? One example comes from Brim (2013), who argues that "warrior ethos" is central to military culture. This promotes self-sacrifice, emotion suppression and pain tolerance and directly contrasts with a civilian or healthcare culture that espouses the importance of seeking help, expressing emotions and reducing pain. These fundamental differences between civilian and military ethos should be recognised and respected. A failure to do so runs the risk of pathologising thoughts, emotions and behaviours that are representative of military culture, and therefore potentially alienating clientele and reinforcing stigma.

1.3.3.3 Challenges reintegrating into civilian life

Whilst many combat veterans adjust successfully when returning to civilian life, some may face significant challenges in relation to reintegration. These include difficulties with combat veterans' relationships with others, with many reporting feeling alienated and unable to relate to friends, family or spouses (e.g. Gold et al., 2007; Hall, 2013). Combat veterans may also struggle with resuming their roles within the community (Doyle & Peterson, 2005), with obtaining or sustaining employment, and with substance misuse (Maguen et al., 2009). Veterans also commonly report changes in their sense of identity, such as a loss of meaning

or a feeling of leading a 'double life' or having separate identities (Brewin et al., 2011; Hall, 2013). These adjustment difficulties have been conceptualised as a series of specific paradoxes, many of which map onto key characteristics of PTSD (Castro et al., 2015). For instance, hyperarousal corresponds with the 'Morpheus paradox', which occurs when military personnel returning from deployment may simultaneously feel physically and mentally exhausted but cannot sleep and are constantly on edge. Threat vigilance and avoidance correspond with the 'safety paradox', whereby people may feel as though they survived, and therefore that nothing can harm them, whilst simultaneously feeling as though the world is an unsafe place and they can never turn their back on anyone.

Although warzone-related difficulties such as social isolation or poor unit cohesion are associated with negative health outcomes, veterans with PTSD are also adversely affected by difficulties at home (Iversen et al., 2005). Supporting combat veterans to reintegrate is thus of vital importance, and significant efforts have gone into developing packages of support that facilitate adjustment and mitigate the risks of developing mental health difficulties.

What post-operational stress management programmes have been developed in order to prevent psychological ill health and promote reintegration amongst combat personnel? Firstly, a mandatory component of tours of duty for combat soldiers within the UK is 'decompression': a period of structured, supportive and yet informal 'unwinding', generally in a neutral location (neither home nor the region of deployment). Secondly, Trauma Risk Management (TRiM) involves engaging with personnel immediately after exposure, as well as four weeks and three months later. This follow-up is key, since nearly half of all cases of military PTSD are of delayed onset (Goodwin et al., 2012). This programme aims to identify those at risk of developing mental health problems and to counteract difficulties with help-seeking, resulting from mental health stigma (Greenberg et al., 2008). There is evidence to suggest that TRiM boosts resilience (Frappell-Cooke et al. 2010) and that troops report finding decompression helpful (Fertout et al., 2011), especially as a means of reducing alcohol misuse and general mental distress (Jones et al., 2014). However, this is only the case for individuals with low to moderate combat exposure, and there is little robust evidence that decompression or early intervention psychoeducational programmes (such as Battlemind UK) are an effective means of preventing the development of PTSD (Fertout et al., 2011; Mulligan et al., 2013). In general, further exploration of the transition period is needed, since research suggests that PTSD symptomatology increases between first returning home and up to 8 months later (Banwell et al., 2015).

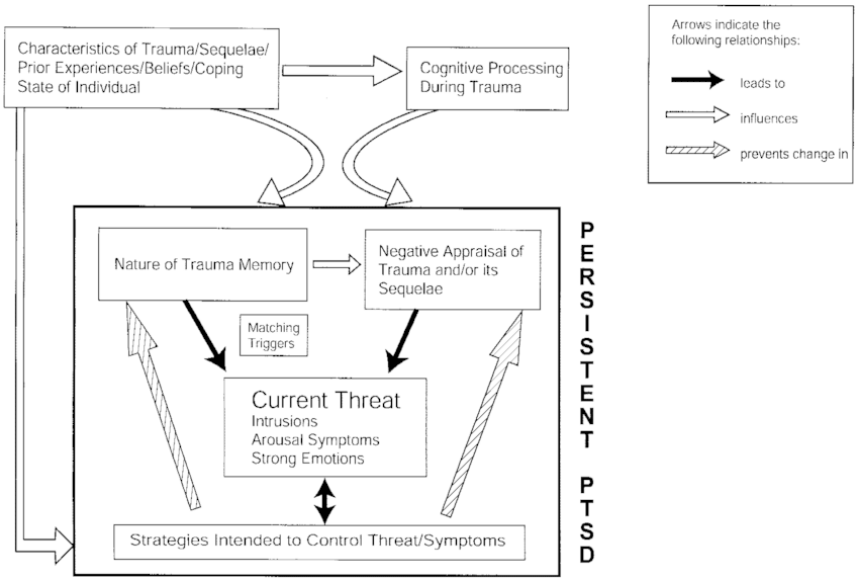
In summary, in comparison with civilian groups, combat personnel are at greater risk of developing PTSD, their symptoms tend to be more severe and chronic, and they appear less likely to seek help. There are many possible reasons for these differences in presentation, including greater exposure to traumatic events, stigma, clinicians' poor understanding of military culture and problems associated with reintegration into civilian life. Adjustment difficulties in particular are associated with worse outcomes for combat personnel with PTSD. It is unclear whether the packages of support that are routinely offered to combat personnel to aid reintegration are effective as preventative measures for PTSD, especially for those with the highest levels of combat exposure who are therefore most at risk.

In order to understand more about combat-related PTSD, it is important to consider the mechanisms involved in the development and maintenance of PTSD in general, and how these might differentially affect combat personnel.

1.4 A COGNITIVE MODEL OF PTSD

For PTSD in general, the cognitive model developed by Ehlers and Clark (2000) is a useful way to conceptualise symptoms and understand the development and maintenance of the disorder. It suggests that prominent PTSD symptoms such as intrusions and hyperarousal, which give rise to a current sense of threat, are influenced by a) the nature of trauma memory, and b) negative appraisals of the trauma and/or its sequelae (see figure 1.1 for further detail).

Figure 1.1 A cognitive model of PTSD (Ehlers & Clark, 2000)



With respect to the nature of trauma memory, there is substantial evidence to suggest that memories of traumatic events can often be fragmented and consist of primarily multisensory impressions rather than coherent thoughts, differing from other autobiographical memories (e.g. Brewin, 2011). This means that traumatic memories lack contextual information that denotes a specific time and place, and sensory features of the present environment that are shared with the past traumatic event can lead to intrusive symptoms (Ehlers & Clark, 2000). Whilst this is an important feature of PTSD, it is unlikely that the nature of traumatic memories differs between PTSD in general vs. combat populations. By contrast, the two populations may be differentiated by the second maintaining mechanism described above: negative appraisals about the trauma or associated consequences. The systematic tendency to process information in a way that consistently leads to negative appraisals is referred to as cognitive bias. The ways in which cognitive biases may have specific relevance for the maintenance of PTSD in combat personnel will be discussed in greater detail below.

1.5 THE ROLE OF COGNITIVE BIASES IN COMBAT-RELATED PTSD

1.5.1 How do cognitive biases maintain PTSD symptoms?

For people with PTSD (stemming from any traumatic event), cognitive models purport that emotional distress arises from biased appraisals relating to impending threat (Ehlers & Clark, 2000). These misappraisals take the form of negative cognitions, such as "the world is unsafe", "no one is trustworthy" and "I am weak" and are said to be the products of cognitive biases (Nanney et al., 2015). For instance, a cognitive bias whereby people tend to overgeneralise learning from a traumatic event leads them to perceive everyday activities as dangerous and negative outcomes as more likely. This bias might lead to negative cognitions such as "If I am not on guard, I will be attacked".

Misappraisals arising from cognitive biases can in turn lead to dysfunctional behavioural strategies, such as avoidance or social withdrawal, in addition to cognitive strategies such as thought suppression or rumination (Ehlers & Clark, 2000). These strategies might help in the short-term by providing temporary relief and a sense of safety. However, in the long-term, they perpetuate symptoms by preventing people from learning that their expectations may be inaccurate, and that discontinuing their strategies will not automatically produce the feared outcome. Another way in which cognitive biases maintain PTSD symptoms pertains to people's limited information processing capacity; ability to process information, and the preferential processing of negative or threat-related information reduces opportunities for the processing of benign or positive information (Beck & Clark, 1997; Bomyea et al., 2017).

In what way might cognitive biases be distinct for combat soldiers versus the general population? Firstly, cognitive biases are thought to develop on the basis of individual predisposition and experience. Greifeneder et al. (2017) argue that people construct a personal, "subjective social reality", and that it is this social reality rather than objective input that dictates their interpretation of events and behavioural responses. Combat soldiers are likely to have relatively unique personal experiences in comparison with the general population, with higher exposure to traumatic events and more prolonged periods of danger. Their biases in information processing are therefore likely to be influenced by a different subjective social reality. Secondly, as described above, people in the general population with PTSD are likely to adopt dysfunctional behavioural strategies to manage their distress and make themselves feel safer. Combat soldiers, who experience more severe and enduring PTSD symptoms (e.g. Brinker et al., 2007), are more likely to remain vigilant to threat than their civilian counterparts (Henigsberg et al., 2001). There are also higher rates of substance misuse in combat soldiers with PTSD relative to those without PTSD (Bremner et al., 1996); comorbid substance misuse is also more prevalent in combat soldiers with PTSD than in individuals with PTSD stemming from alternative sources of trauma (Deering et al., 1996).

Taken together, there are a number of hypothetical ways in which the link between cognitive biases and ongoing PTSD symptoms is stronger for combat personnel than the general public, but limited research has contrasted these groups directly. Nonetheless, substantial research has examined specific cognitive biases that contribute to the maintenance of PTSD symptoms; these will be reviewed below.

1.5.2 Specific cognitive biases implicated in PTSD in the general population

The research literature emphasises the association between three types of cognitive bias and PTSD in general (e.g. Constans, 2005; Bomyea et al., 2017): memory bias, attentional bias and judgment bias.

Memory bias refers to systematic impairments or fallacies in the encoding or retrieval of memories, such that recollection of previous experiences is distorted by current knowledge, belief or emotion (Schacter, 1999). For instance, people may exaggerate the consistency between their current and previous beliefs about social issues, when in reality these may have changed over time (Markus 1986). There is some evidence to suggest that people with versus without PTSD encode or retrieve trauma-related information more readily than more

innocuous information (e.g. Amir et al., 1996; Golier et al., 2003; see Bomyea et al., 2017, for a recent review).

Attentional bias refers to the tendency to allocate attention towards stimuli that are perceived as threatening. Although redirecting attention towards danger or strong threat is evidently an adaptive strategy (Mogg & Bradley, 1998), people with high levels of anxiety are sensitive to even mildly threatening stimuli. Continuous attentional bias towards mild threat may lead to increased stress and chronic hyperarousal, thus contributing directly to the development and maintenance of PTSD (Mathews & MacLeod, 2002). There is substantial evidence to suggest that in comparison with healthy controls, people with PTSD demonstrate attentional bias; they are more sensitive to and easily distracted by mildly threatening stimuli (e.g. Constans, 2005; Bomyea et al., 2017)

With respect to judgment bias, two specific types have been implicated in PTSD: subjective risk bias and interpretation bias (Constans, 2005). Subjective risk bias describes the increased perception of threat in the environment and the tendency to overestimate the likelihood of negative events taking place in future. For instance, symptoms of acute stress and PTSD are associated with a propensity to judge future negative events as more probable and more negatively impactful (Thrasher & Dalgleish, 1999; Warda & Bryant, 1998). In contrast with subjective estimates of risk, which are future-focused, interpretation bias (which is also subjective) describes the way in which people make judgements about current, ambiguous information. There is a body of literature highlighting the role of interpretation bias in PTSD. For example, one study found that combat veterans with PTSD were more likely to complete ambiguous sentences with threat-related words than those without PTSD (Kimble et al., 2002). Another study found that people who had been victims of interpersonal trauma judged threatening endings of ambiguous social situations as more predictable and more likely to escalate in risk than did non-victims (Elwood et al., 2007). Furthermore, Kimble et al. (2012) presented trauma survivors with incomplete, ambiguous sentence stems (e.g. 'the unfortunate man lost his…'). These sentence stems were completed with either expected (e.g. 'lost his…wallet'), unexpected (e.g. 'lost his…artist'), or threatening (e.g. 'lost his…leg') word endings. Trauma survivors with vs. without PTSD were more likely to judge threatening sentence endings as logical and had faster neural responses (as indicated by smaller event-related potentials or ERPs as measured by electroencephalography). This led the authors to conclude that those with vs. without PTSD had enhanced expectancy of threat and that this occurred at the early stages of information processing. Despite its evident

relevance for PTSD, interpretation bias has been understudied in comparison with memory and attention biases (Bomyea et al., 2017). Interpretation bias may be particularly implicated in combat-related PTSD; this will be discussed further below.

1.5.3 Interpretation bias and combat-related PTSD

As described above, cognitive biases are generally thought to be adaptive ways to make rapid, efficient decisions. With respect to biases implicated in PTSD, combat environments are by definition risky, and thus the ability to recall threat-related information readily, to attend rapidly to threat and to assess risks when deciding on behaviour are effective strategies in that particular context (Castro et al., 2015). With respect to interpretation bias specifically, people with PTSD in the general population are often described as having an "exaggerated subjective sense of risk" (Bomyea et al., 2017). By contrast, combat veterans may have spent extended periods of time in an environment that is objectively 'risky'. Interpreting ambiguous information as dangerous may be a helpful way to remain safe whilst combat soldiers are deployed. However, this strategy may no longer be appropriate once they have returned home, and the tendency to "assume the worst" may lead combat personnel to persist with warzone levels of threat-vigilance, which has been found to predict post-combat PTSD symptoms (Wald et al., 2013) and has also been linked to chronic sleep difficulties after returning to civilian life (Babson et al., 2012). These in turn are linked to poorer outcomes for individuals with PTSD.

It is therefore possible that attenuated interpretation bias upon return to civilian life is associated with easier reintegration, whereas its persistence is associated with greater PTSD symptomatology. Alternatively, it is possible that interpretation bias is a feature of combat exposure rather than PTSD. However, no studies to date have contrasted cognitive appraisals of ambiguous situations in combat personnel with vs. without PTSD, nor have studies of interpretation bias in combat veterans included a civilian group to elucidate the relative contributions of combat exposure versus PTSD symptomatology.

1.6 MEASURING INTERPRETATION BIAS

The majority of studies investigating interpretation bias have involved experimental paradigms such as lexical decision-making tasks that may lack ecological validity. Moreover, many studies have used combat-related stimuli, which prohibits examination of interpretation bias in relation to commonplace, ambiguous situations people are more likely to face after reintegrating into civilian life. Thus, the present research aimed to explore how

combat veterans with and without PTSD interpret everyday, non-combat situations that could be construed as threatening.

An established measure of interpretation bias was used: the Bodily Sensations Interpretations Questionnaire (BSIQ; Clark et al., 1997). The BSIQ is a self-report measure of interpretation bias that consists of ambiguous scenarios that could be construed as threatening. The scenarios can be divided into four subscales: hyperarousal/panic symptoms and general health symptoms (both forms of internal threat), social events and general events (both forms of external threat). The BSIQ was initially developed to investigate the misinterpretation of bodily sensations in panic disorder but has since been used to assess interpretation bias in social phobia (e.g. Amina et al., 1998) and trait anxiety (Richards et al., 2001; Teachman, 2005). Another study administered the BSIQ to a sample of women who had survived intimate partner violence and found that negative interpretation bias and poor coping skills were linked with greater PTSD symptom severity (Lambert et al., 2013). It was therefore deemed to be an appropriate choice of measure of interpretation bias in the current study.

1.7 THE CURRENT STUDY

Despite the fact that the concept of PTSD stems from combat-related experiences and that PTSD is more common, severe and persistent in combat veterans, there is a paucity of work examining cognitive biases in this group. In particular, given the advantages of remaining threat-vigilant in the context of combat, the extent to which interpretation bias can be considered pathological in a combat veteran sample is unclear. Interpretation bias might be a feature of combat exposure rather than PTSD. Alternatively, its persistence in civilian life, once the objective level of threat is substantially lower, could differentiate between PTSD and non-PTSD veterans.

The current study aimed to address this question by using the BSIQ to compare interpretation bias in combat veterans with PTSD, combat veterans without PTSD, and civilian controls. Although the relationship between military PTSD and interpretation bias was the primary focus of the current research, PTSD symptom severity has been linked with catastrophising about the future (e.g. Carty et al., 2011) and poor coping skills (Olff et al., 2005; Lambert et al., 2013). It was therefore felt that these factors might differentiate the groups, and participants' judgments about future consequences and coping skills were also elicited.

1.8 HYPOTHESES

It was expected that in relation to performance on the BSIQ:

1. Veterans with PTSD would generate more negative interpretations of ambiguous scenarios than veterans without PTSD and civilian controls.
2. When presented with different possible interpretations, those with PTSD would judge negative interpretations as more likely than either control group.
3. When asked to imagine that the negative interpretation was true, it was expected that participants with PTSD would judge the future to be more catastrophic and to rate themselves as less able to cope in comparison with either control group.
4. The two control groups (combat veterans without PTSD and civilians without PTSD) would not differ on any aspect of the BSIQ.
5. With respect to the four different types of scenarios within the BSIQ, any group differences might be exacerbated in relation to scenarios that describe general events in the world and scenarios describing social interactions with other people (external threat) rather than scenarios describing panic-related symptoms or those describing other general health symptoms (internal threat).

2. METHODS

2.1 ETHICAL APPROVAL

Ethical approval was obtained from the King's College London Research Ethics Committee (see Appendix 1 for approval letter).

2.2 DESIGN

There was one between-participants factor of group membership (veterans with PTSD vs. veterans without PTSD vs. controls). There was one within-participants factor of scenario type (hyperarousal symptoms vs. other health symptoms vs. social events vs. general events).

2.3 PARTICIPANTS

Three groups of participants were recruited: combat veterans with PTSD, combat veterans without PTSD and members of the general population who had no military experience and had never experienced difficulties related to PTSD. Veterans with PTSD were recruited from Combat Stress, a UK-based charity that offers support to veterans with mental health difficulties, via either letters or open online advertisement. Veterans without PTSD were recruited via the Kings Centre for Military Health Research (KCMHR) from a cohort of military personnel who deployed to the 2003 Iraq War (see Hotopf et al., 2006 for details of cohort). Those in the cohort who had consented to being contacted to take part in further research, had not previously met criteria for PTSD and identified as primarily occupying a combat role were contacted by email. Civilian participants were opportunistically recruited via online adverts. Given that the majority of combat veterans are male, the current study only recruited male participants. Thus, the final sample comprised 20 veterans with PTSD (mean age 43.90; SD 9.03), 22 veterans without PTSD (mean age 43.05; SD 8.61) and 20 civilian participants (mean age 42.45; SD 11.21). Sample sizes were determined in accordance with the guidelines set out by Cohen (1992), indicating that a sample size of 20 participants per group is necessary to detect a large effect size, with power set at 80% and alpha at 10%. These sample sizes were also comparable with other research work involving veterans with and without PTSD and civilian controls (e.g. Armstrong et al., 2013).

2.4 PROCEDURE

In view of the veteran participants' combat exposure, and the possible risk of emotional distress associated with these experiences, it was agreed that a researcher would remain on the phone with veteran participants, in case additional emotional support was needed. Thus,

as detailed above, veteran participants were contacted by letter, email, or online advert with an invitation to participate in the current study. A comprehensive information sheet and consent form were attached to the invitation. Participants responded to the invitation by contacting the researcher directly. After agreeing a date and time to take part and providing contact details, participants were called directly and were simultaneously sent a study weblink. Civilian participants were recruited via an online advert that described the overall aims of the study and provided both a study email address for any queries and the study weblink. The study website contained an information sheet reiterating the broad aims of the study and explaining participants' right to withdraw, alongside an online consent form (see Appendices 2-7 for all cover letters, information sheets and consent forms). After providing online consent, participants were directed to online versions of the Bodily Symptoms Interpretations Questionnaire (BSIQ), the PTSD checklist (PCL), and the COPE Inventory. For the BSIQ, each question was presented on a separate page, with participants clicking a button to be taken forward to the next page. All questions for the PCL and COPE were presented on a page each. A researcher remained on the telephone to veteran participants while they completed the online survey to provide emotional support; no additional support with task completion was provided. All participants were paid for their participation.

2.5 MATERIALS

2.5.1 Bodily Sensations Interpretations Questionnaire (BSIQ)

2.5.1.1 BSIQ task description

The BSIQ (Clark et al., 1997) is a measure comprising 27 brief scenarios describing ambiguous situations that could be interpreted as threatening (see Figure 2.1). These scenarios are categorised into four main subtypes: hyperarousal or panic sensations (n=7), other general health symptoms (n=6), social events (n=8) and general events (n=6). Hyperarousal and health symptom items describe an internal sense of threat, whereas social and general event items pertain to external threat (see Figure 2.1 for example scenarios). Although initially developed to investigate the misinterpretation of bodily sensations in panic disorder, it has since been found to be a sensitive measure for those with social phobia, trait anxiety and PTSD.

Figure 2.1: Sample scenarios from the BSIQ

Hyperarousal scenario: "You notice your heart is beating quickly"

1. Why?
2. Please arrange the following explanations in order of likelihood:
    a. Because you have been physically active.
    b. Because there is something wrong with your heart.
    c. Because you are feeling tired.

General health scenario: "You have been eating normally but have recently lost some weight"

1. Why?
2. Please arrange the following explanations in order of likelihood:
    a. You have cancer.
    b. It's a normal fluctuation.
    c. You have been rushing around more than usual.

Social event scenario: "An old acquaintance passes you in the street without acknowledging you"

1. Why?
2. Please arrange the following explanations in order of likelihood:
    a. They recognised you but think you're not worth talking to.
    b. Your appearance has changed since they last saw you and so they did not recognise you.
    c. They had other things on their mind.

General event: "A crisis comes up at work and you can't immediately think of what to do"

1. Why?
2. Please arrange the following explanations in order of likelihood:
    a. It's an unusual situation which you haven't encountered before.
    b. You need a moment to think about a solution.
    c. You are inadequate to deal with the problem.

Follow-up questions (for all items):
Hyperarousal scenario: "You notice your heart is beating quickly". How likely are each of the following explanations:

a. How likely is this because you have been physically active?
b. How likely is this because there is something wrong with your heart?
c. How likely is this because you are feeling tired?

0_____2_____4_____6_____8

Not at all likely | A little | Moderately | Very | Extremely likely

Imagine that your heart is beating quickly and pounding because there is something wrong with your heart.

What would the future be like if this were true?

a) There would be little to no long-term change for me
b) There would be some negative consequences, but I would be able to overcome these
c) There would be several negative consequences that would be difficult to overcome
d) It would be impossible to overcome the consequences of this happening

How would you rate your ability to cope?

0_____10

Completely unable to cope | Completely able to cope

2.5.1.1.1 Verbal interpretations

Participants were initially required to generate an explanation about what is happening in each scenario and were then asked to rank three possible explanations, one of which was negative, in order of likelihood.

2.5.1.1.2 Ranking and ratings of likelihood of negative outcomes

After participants did this for all 27 items, they reviewed the scenarios again and this time provided likelihood ratings for each set of three explanations on a scale of 0-8 (0=not at all likely, 8= extremely likely).

2.5.1.1.3 Imagining the future and coping

In an extension of the original task, participants in the current study were also asked to make two further judgments. Firstly, they were asked to judge what the future would be like if the worst-case scenario were true. They chose between four possible options: little to no change, some negative consequences that would be possible to overcome, several negative consequences that would be difficult to overcome, and consequences that would be impossible to overcome. Secondly, they were asked how able they would feel to cope with the situation, on a scale of 0-10.

2.5.1.2 BSIQ scoring

2.5.1.2.1 Scoring of verbal interpretations

Participants' verbal responses were firstly classified with respect to whether they made explicit reference to their own anxiety symptoms, gave some other negative interpretation, provided a neutral explanation or gave a response that could not be classified (e.g. "I don't know"; see Figure 2.2 for example responses). All responses were given a score of 0 if they were neutral or unclassifiable, and a score of 1 if anxiety-related or any other negative interpretation; these scores were summed across all items to give a total negative interpretation score. Separate total scores were created for each of the four types of scenario items (hyperarousal, general health, social event and general event). Percentages were then created in order to account for the different number of items per scenario subtype.

2.5.1.2.2 Scoring ranking and ratings of likelihood of negative outcomes

Participants were awarded a score of 3, 2 or 1 for each item depending on how they ranked them. For instance, if the most negative interpretation was ranked first, a score of 3 was awarded; if ranked second, a score of 2 was awarded and if ranked third, a score of 1 was

awarded. The remaining two interpretations were not scored. Scores denoting participants' rankings of the negative interpretations were then summed across each items, with higher scores denoting greater endorsement of the negative interpretation. Participants' ratings pertaining to the likelihood of each negative interpretation were also summed across items; the likelihood ratings for the remaining two interpretations were not included in the scoring. As above, percentages were calculated for each scenario subtype for both ranking and rating data.

2.5.1.2.3 Imagining the future

Participants were asked to imagine what the future would be like if the negative interpretation were true and were awarded a score of 3, 2, 1 or 0 depending on the extent to which they felt there would be negative consequences that would be difficult to overcome. For instance, if participants felt there would be little to no change, they were given a score of 0 and if they felt the consequences would be impossible to overcome, they were given a score of 3. These scores were summed across scenarios, with higher scores pertaining to more catastrophic beliefs about the future, and percentages calculated for each scenario subtype.

2.5.1.2.4 Coping

Participants were also asked to rate their ability to cope if the negative interpretation were true; these ratings were also summed across items, with higher scores denoting greater coping ability. Once again, percentages were calculated for each scenario subtype.

Figure 2.2: Example participant responses to the BSIQ from the current study

Negative responses

Anxiety-related interpretation:

"Start of an anxiety attack" (hyperarousal scenario)

"Stressing too much about everything (general health scenario)

"They know I have PTSD and are uncomfortable" (social event scenario)

"I'm panicking" (general event scenario)

Other negative interpretation:

"Being in an alien and uncomfortable environment (hyperarousal scenario)

"Cancer" (general health scenario)

"They are rude" (social event scenario)

"I'm in trouble" (general event scenario)

Neutral responses

Non-negative interpretation:

"I've been exercising" (hyperarousal scenario)

"Exercising more" (general health scenario)

"They did not see me because they were distracted" (social event scenario)

"I don't have all the information I need" (general event scenario)

Unclassifiable

"I don't know" (any scenario)

"This is weird" (any scenario)

2.5.2 PTSD Checklist (PCL)

The PCL (Weathers & Ford, 1996) is a self-report questionnaire comprising 17 items that describe problems that arise following stressful life events and correspond with PTSD symptoms described in DSM-IV. Respondents were asked to indicate the extent to which they have been bothered by these over the past month. The items correspond to key symptoms of PTSD such as re-experiencing (e.g. "repeated disturbing memories, thoughts or images of a stressful experience from the past"), hypervigilance (e.g. "being super alert, watchful or on guard") and avoidance (e.g. "avoiding memories, thoughts, or feelings related to the stressful experience"). Each item is on a 5-point, Likert-type scale with 'not at all', 'a little bit', 'moderately', 'quite a bit' and 'extremely' as possible responses. PCL scores range from 17-85 and the measure has been shown to have strong convergent validity, since it correlates well with measures such as the Impact of Events Scale (r=.90). It also

demonstrates good internal consistency (Cronbach's alpha .97) and strong test-retest reliability (r=.96).

2.5.3 COPE Inventory

The COPE inventory is a self-report questionnaire that assesses different strategies people adopt when responding to stressful life events. The questionnaire consists of 60 items, that fall into 15 distinct coping strategies. Participants were asked to rate the extent to which they adopt each strategy on a 4-point, Likert-type scale with 'I usually don't do this at all', 'I usually do this a little bit', 'I usually do this a medium amount' and 'I usually do this a lot' as possible responses. Litman (2006) conducted factor analysis on the COPE inventory and proposed four factors, corresponding to broad coping styles: self-sufficient (problem-focus), self-sufficient (emotion focus), socially supported and avoidant coping. Item examples are included in Figure 2.3. Items falling within each of the four factors were summed to derive four factor scores, with higher scores denoting greater endorsement of the coping style. The measure has good internal consistency (Cronbach's alpha .79) and demonstrates both convergent and discriminant validity (Carver et al., 1989).

2.6 STATISTICAL ANALYSIS

Analysis of variance (ANOVA) was used to compare the three groups on each of the measures. A significance level of .05 was adopted in the current study; an adjusted significance value of .01 was applied to any post-hoc t-tests. Parametric tests were used since these have greater power to reject a false null hypothesis than non-parametric equivalents (e.g. Howell, 1997) and offer greater scope for multivariate analysis.

Figure 2.3: sample items from the COPE Inventory:

Factor 1: Self-sufficient (problem-focus):	
Strategy 1: Active coping	*"I concentrate my efforts on doing something about it"*
Strategy 2: Suppression of competing activities	*I keep myself from getting distracted by other thoughts or activities"*
Strategy 3: Planning	*"I make a plan of action"*
Factor 2: Self-sufficient (emotion-focus):	
Strategy 4: Positive reinterpretation and growth	*"I try to grow as a person as a result of the experience"*
Strategy 5: Religious coping:	*"I put my trust in God"*
Strategy 6: Humour:	*"I laugh at the situation"*
Strategy 7: Restraint:	*"I make sure not to make matters worse by acting too quickly"*
Strategy 8: Acceptance:	*"I accept that this has happened and that it can't be changed"*
Factor 3: Socially supported	
Strategy 9: Focus on and venting of emotions:	*"I get upset and let my emotions out"*
Strategy 10: Use of instrumental social support:	*"I try to get advice from someone about what to do"*
Strategy 11: Use of emotional social support:	*"I get sympathy and understanding from someone"*
Factor 4: Avoidant coping	
Strategy 12: Mental disengagement:	*"I go to the movies or watch TV to think about this less"*
Strategy 13: Denial:	*"I refuse to believe that it has happened"*
Strategy 14: Behavioural disengagement:	*"I admit to myself that I can't deal with it and quit trying"*
Strategy 15: Substance use:	*"I use alcohol or drugs to help me get through it"*

3. RESULTS

Table 3.1 Means and standard deviations for all variables

	PTSD+ Veterans Mean (SD) (N=20)	PTSD- Veterans Mean (SD) (N=22)	Civilians Mean (SD) (N= 20)
BSIQ			
Negative interpretation rankings (%)			
Hyperarousal symptoms	50.71 (14.10)	40.91 (10.96)	40.71.7.16
General health symptoms	50.00 (14.64)	42.17 (11.59)	38.89 (6.74)
Social events	73.96 (20.98)	45.83 (12.73)	43.75 (10.69)
General events	60.56 (17.09)	40.66 (8.64)	39.72 (9.58)
Negative interpretation likelihood ratings (%)			
Hyperarousal symptoms	34.38 (21.03)	19.16 (10.25)	17.32 (7.73)
General health symptoms	32.71 (21.80)	30.11 (12.98)	19.90 (8.04)
Social events	49.69 (24.82)	27.06 (16.11)	26.09 (11.54)
General events	40.73 (19.29)	23.01 (10.88)	23.54 (12.19)
Verbally generated negative interpretations (%)			
Hyperarousal symptoms	52.14 (21.88)	13.64 (16.18)	21.43 (11.82)
General health symptoms	19.17 (20.43)	8.33 (11.21)	5.00 (12.21)
Social events	45.63 (30.15)	17.04 (20.97)	17.50 (17.86)
General events	39.17 (23.11)	11.36 (13.98)	6.67 (11.34)
Catastrophising (%)			
Hyperarousal symptoms	51.19 (20.37)	44.81 (10.15)	51.43 (14.87)
General health symptoms	53.06 (21.13)	45.71 (10.42)	49.72 (14.47)
Social events	37.92 (19.68)	12.88 (10.28)	15.83 (10.00)
General events	51.39 (15.91)	40.91 (9.00)	39.72 (13.28)
Coping ability (%)			
Hyperarousal symptoms	44.57 (17.25)	76.23 (13.32)	61.86 (13.59)
General health symptoms	42.42 (19.06)	86.68 (32.91)	61.67 (14.31)
Social events	57.88 (21.94)	94.38 (8.21)	81.19 (8.91)
General events	48.75 (19.37)	81.89 (13.37)	67.00 (14.56)

	PTSD+ Veterans Mean (SD) (N=20)	PTSD- Veterans Mean (SD) (N=22)	Civilians Mean (SD) (N= 20)
PCL			
Total PCL Score	71.65 (4.81)	23.86 (74.43)	29.90 (10.74)
COPE INVENTORY			
Self-sufficient problem-focused (%)	33.61 (18.69)	53.16 (26.68)	55.28 (19.05)
Self-sufficient emotion-focused (%)	25.08 (11.35)	38.33 (13.63)	43.50 (14.33)
Socially supported (%)	31.67 (18.69)	31.44 (22.59)	39.86 (18.54)
Avoidant (%)	37.19 (17.06)	8.71 (5.70)	19.79 (12.94)

3.1 DATA CHECKS

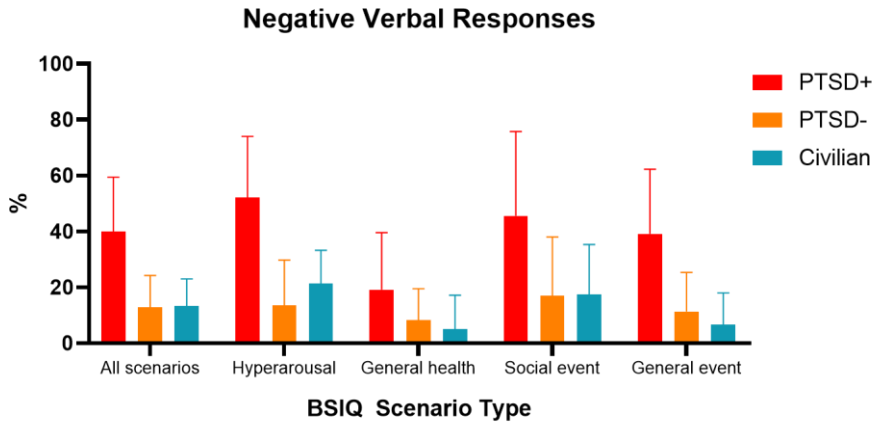
In order to ensure that the assumptions of normality underlying parametric tests were met by the present data, tests for skewness and outliers were carried out. Skewness was determined by the Shapiro-Wilk test, and data points were judged to be outliers if they did not fall within three standard deviations of the mean. All but three variables were normally distributed (negative rankings, negative verbal responses and coping ability). One method of adjusting data to reduce skewness is to perform a transformation. Appropriate transformations were decided up on using Tukey's 'ladder of transformations' (Erickson & Nosenchuk, 1992). However, the non-normally distributed variables in the current study could not be transformed to normality using this method. Non-parametric tests (independent-samples Kruskal-Wallis) were therefore performed, and these revealed a similar pattern of results to the parametric tests; parametric analyses have therefore been reported throughout. Four data points were found to fall outside of three standard deviations of the mean. However, excluding these participants did not change the pattern of results (and doing so is generally considered to be poor practice) and therefore all data have been included in the current analysis. All means and standard deviations are presented in Table 3.1.

3.2 BSIQ

3.2.1 Generated verbal responses

Veterans with PTSD (PTSD+), veterans without PTSD (PTSD-) and civilian controls were compared with respect to the number of negative interpretations they generated when providing explanations for ambiguous events (see Figure 3.1). A 3x4 ANOVA was conducted with one between-groups factor (PTSD+ veterans/PTSD- veterans/civilians) and one within-groups factor (scenario type: hyperarousal symptom/other health symptom/social event/general event). There was a main effect of group ($F(2, 59)=25.211$; $p<.001$). Pairwise comparisons indicated that veterans with PTSD were significantly more likely to generate negative interpretations than both PTSD- veterans ($p<.001$) and civilian participants ($p<.001$) and that the two control groups did not differ significantly ($p>.05$). There was also a main effect of scenario type ($F(3, 57)= 28.125$; $p<.001$); pairwise comparisons revealed that regardless of group membership, scenarios describing health symptoms were interpreted significantly less negatively than all other scenario types (p values ranging from .008 to <.001) and hyperarousal scenarios were interpreted significantly more negatively than general events ($p<.001$). Lastly, there was a significant interaction between group and scenario type ($F(3, 58)=8.85$; $p<.001$). Post-hoc t-tests were conducted to elucidate the nature of this interaction (and an adjusted significance value of .01 was adopted). These tests revealed that although the veterans with PTSD generated more negative interpretation than both control groups across all scenario types, these differences were strongest for hyperarousal, social events and general events ($p<.001$) and weakest for other health symptoms ($p=.011$).

Figure 3.1: BSIQ Verbally generated negative responses

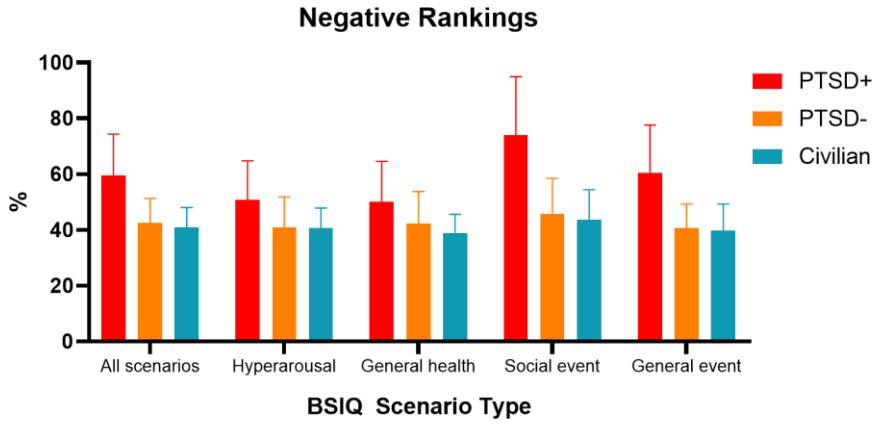


3.2.2 Endorsement of negative interpretations

3.2.2.1 Ranking likelihood of negative outcomes

Participants were compared with respect to how they ranked the likelihood of negative interpretations in the BSIQ (see Figure 3.2). There was a significant main effect of group ($F(2, 59)=18.53$; $p<.001$). Pairwise comparisons revealed that the PTSD+ veterans ranked negative interpretations as significantly more likely than both PTSD- veterans and civilian participants ($p<.001$) and that the two control groups did not differ significantly in their rankings (>.05). There was also a main effect of scenario type ($F(3, 57)=16.749$; $p<.001$): pairwise comparisons found that negative interpretations in social event scenarios were as ranked as significantly more likely than all other scenario types ($p<.001$). Lastly, there was a significant interaction between group and scenario type $F(3, 58)=13.548$; $p<.001$). Post-hoc t-tests (adopting a stricter significance level) revealed that group differences were exacerbated in social event ($p<.001$) and general event scenarios ($p<.001$) compared to the other scenario types (p>.05).

Figure 3.2: BSIQ Negative rankings

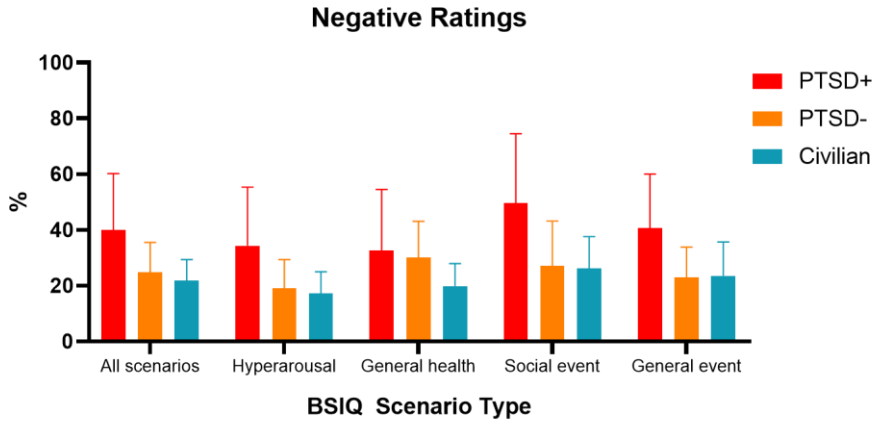


3.2.2.2 Rating likelihood of negative outcomes

The groups were also compared with respect to how likely they judged each negative interpretation to be (see Figure 3.3). There was once again a main effect of group ($F(2, 59)=9.567$; $p<.001$); pairwise comparisons indicated that the PTSD+ veterans rated negative interpretations as more likely than both PTSD- veterans ($p=.003$) and civilian participants ($p<.001$) and the two control groups did not differ significantly (p>.05). There was also a main effect of scenario type ($F(3, 57)= 12.649$; $p<.001$); regardless of group membership, all participants judged the negative interpretation in hyperarousal scenarios as less likely than in

any other scenario type (*p* values ranging from .003 to <.001). Negative interpretations in social scenarios were also rated as more likely than those in scenarios describing other health-related symptoms (*p*=.003). Negative interpretations in social scenarios were also rated as more likely than in scenarios describing general events, but this only approached significance (*p*=.017) when adopting a stricter significance level of .01. Finally, there was a significant interaction between group and scenario type ($F(3, 58)=11.714$; $p<.001$). Post-hoc t-tests revealed that PTSD+ veterans rated negative interpretations as more likely than either control group for hyperarousal (*p*.001-.003), social event (*p*≤.001) and general event scenarios (*p*=.001), but not for other health symptoms (p>.05).

Figure 3.3: BSIQ Negative ratings

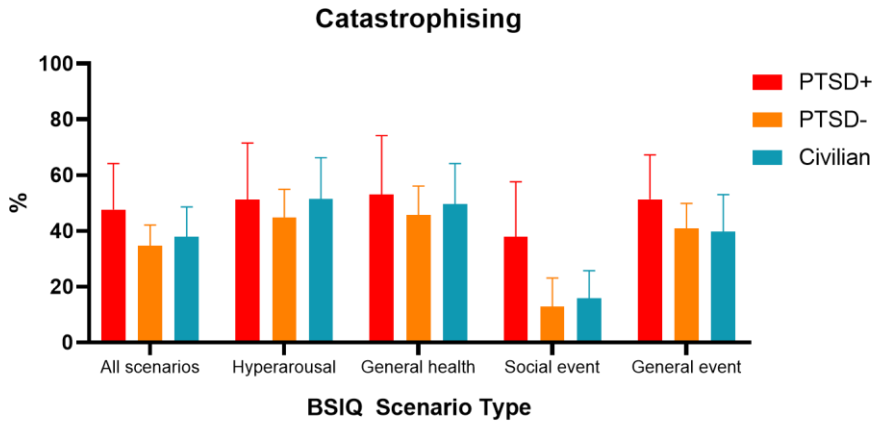


3.2.3 Imagining the future

The groups were compared with respect to their ratings pertaining to the future consequences if the negative interpretations of scenarios were true, with higher scores denoting more catastrophic beliefs (see Figure 3.4). There was a main effect of group ($F(2, 59)=5.807$; $p=.005$); pairwise comparisons demonstrated that PTSD+ veterans rated the future as more catastrophic than PTSD- veterans (*p*.005). However, post-hoc tests did not show significant differences between either veteran group and the civilian control group (p>.05). There was a main effect of scenario type ($F(3, 57)= 28.125$; $p<.001$), such that participants rated negative interpretations of ambiguous social events as significantly less catastrophic than all other scenario types (*p*<.001). There was also a significant interaction between group and scenario type ($F(3, 58)=8.946$; $p<.001$), with post-hoc t-tests revealing that the PTSD+ veterans rated the future as more catastrophic than either control group in

general event (p=.01) and social event (p<.001) scenarios. However, no group differences emerged for scenarios describing hyperarousal or other general health symptoms (p>.05).

Figure 3.4: BSIQ Imagining the future



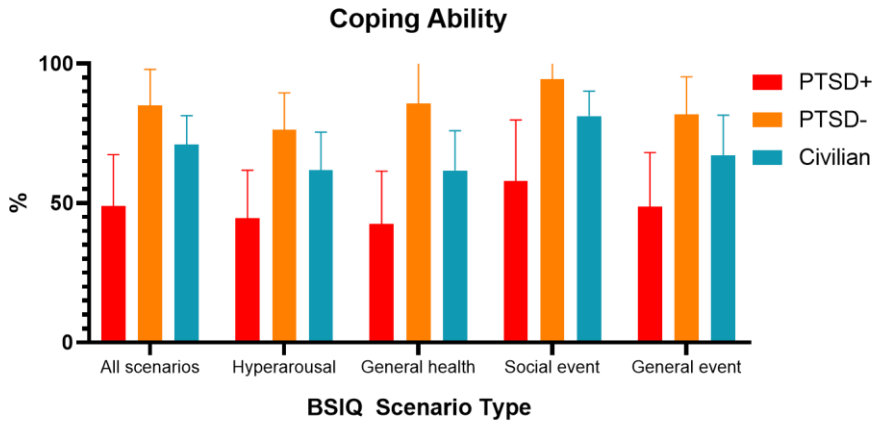
3.2.4 Coping ability

In the final aspect of the BSIQ, participants were asked to imagine that negative interpretations of scenarios were true and to rate their ability to cope (see Figure 3.5). There was once again a main effect of group (F(2, 59)=32.474; p<.001), with pairwise comparisons revealing that PTSD+ veterans rated themselves as significantly less able to cope than either control group (p<.001). In addition, the PTSD- group reported their ability to cope as significantly higher than the civilian control group (p=.006). There was also a main effect of scenario type (F(3, 57)= 58.378; p<.001). Pairwise comparisons found that all participants felt significantly less able to cope in the worst -case scenario interpretation of hyperarousal symptoms compared to social (p<.001) or general events (p=.003), and social events elicited significantly higher coping scores than any other scenario type (p<.001).

Finally, there was a group by scenario type interaction (F(3, 58)=6.019; p=.001); post-hoc t-test were conducted to disentangle this interaction. In the worst-case scenario interpretations of all four scenario types, PTSD+ veterans reported feeling significantly less able to cope than PTSD- veterans (p<.001). PTSD+ veterans also rated their coping ability as significantly lower than the civilian controls for hyperarousal (p=.001), general event (p=.002), and social event items (p <.001); this trend only approached significance for other health symptom items after correcting for post-hoc t-tests (p=.04). Lastly, with respect to the two control groups, the PTSD- veterans judged themselves to be more able to cope in the worst-case

scenario of hyperarousal, general event and other health symptom items (p values ranging from .006 to .011); there were no significant group differences for social event items (p>.05)

Figure 3.5: BSIQ Coping ability



3.3 PCL

Participants completed a self-report questionnaire measure of relating to PTSD symptoms (the PTSD Checklist; PCL). A total score was generated for each participant, and an ANOVA was conducted to compare the three groups. Unsurprisingly, the PTSD+ veterans had significantly higher scores on the PCL than both the PTSD- veterans (p<.001) and the civilian controls (p<.001). The two control groups did not significantly differ in their PCL scores (p>.05).

3.4 COPE INVENTORY

Participants completed a self-report questionnaire measure relating to coping strategies. There were four broad categories of coping: self-sufficient coping strategies that focused on problem-solving, self-sufficient coping strategies that focused on emotional wellbeing, strategies that involved eliciting social support, and avoidant coping strategies. Thus, a 3x4 ANOVA was conducted (group [PTSD+ vs. PTSD- vs. civilian controls] by coping style [self-sufficient problem-focused vs. self-sufficient emotion-focused vs. socially supported vs. avoidant]).

Results revealed no main effect of group (F(2, 59)=2.359; p=.103). However, there was a main effect of coping style (F(3, 57)=20.393; p<.001), whereby all participants reported being significantly more likely to use self-sufficient problem-focused strategies than any other type

of coping strategy (p<.001) and significantly less likely to use avoidant coping strategies than any other type (p<.001).

The most notable finding was that there was a significant interaction between group and coping style (F(3, 58)=31.504; p<.001). When comparing the groups' self-reported use of self-sufficient problem-focused strategies, the PTSD+ group used these strategies to a lesser extent than the civilian controls (p=.008). The PTSD+ group also tended to use these strategies less than the PTSD- group, but after correcting for post-hoc tests, this difference did not meet significance (p=.017). The PTSD+ veterans used self-sufficient problem-focused strategies to a significantly lesser extent than both PTSD- veterans (p=.006) and civilian controls (p<.001). There were no significant group differences with respect to the tendency to elicit social support as a means of coping (p>.05). Lastly, the PTSD+ veterans used avoidant coping strategies to a greater extent than both PTSD- veterans (p<.001) and civilian controls (p<.001). The two control groups did not differ in their self-reported use of any coping styles (p>.05).

4. DISCUSSION

4.1 SUMMARY OF FINDINGS

This study compared combat veterans with PTSD, combat veterans without PTSD, and civilian participants using a measure of interpretation bias. As hypothesised, veterans with PTSD generated more negative explanations for ambiguous situations than the veteran or civilian control groups and also ranked and rated negative interpretations of ambiguous situations as more likely. Also consistent with the hypotheses, veterans with PTSD felt less able to cope with negative outcomes than both control groups. Veterans with PTSD had more catastrophic beliefs about the future than those without PTSD but did not show the predicted difference in comparison with civilian controls.

Since interpretation bias was postulated to be a feature of PTSD rather than a consequence of combat exposure, it was hypothesised that the two control groups would not differ. The findings were broadly consistent with this, with no differences emerging for most variables. However, the control groups differed with respect to their beliefs about their ability to cope with the worst-case scenario. Veterans without PTSD rated themselves as more able to cope than did civilian controls, and this difference was exacerbated for hyperarousal and general event scenarios.

Lastly, it was expected that any group differences would be exacerbated in situations involving possible 'external threat'. The findings were broadly in support of this, with the strongest group differences found in relation to social events and general events and the weakest differences found in relation to general health symptoms. These findings will now be explored in greater depth

4.2 INTERPRETATION OF FINDINGS

4.2.1 Results in relation to interpretation bias

The current study aimed to explore how interpretation bias might differentiate combat veterans with and without PTSD and found that veterans with PTSD tended to generate more negative interpretations and to judge these types of interpretations to be more likely than those without PTSD. The rationale for this study and these findings will now be considered in relation to the relevant literature.

Interpretation bias describes the systematic tendency to judge ambiguous information as negative or threatening (Constans, 2005). Previous research has found enhanced interpretation bias in people with versus without PTSD using a variety of methodologies including an ambiguous sentence completion task (Kimble et al., 2002) and videoclips with ambiguous endings (Elwood et al., 2007). In these studies, participants with PTSD tended to resolve ambiguity with negative or threat-related interpretations, and to judge these interpretations to be more plausible. However, it was unclear how an association between PTSD and interpretation bias might manifest in combat personnel. This lack of clarity is because military personnel in combat zones may adaptively remain vigilant and react rapidly to potential threats. Doing so in a warzone, which is an inherently threatening environment, may save a service person's life. Moreover, previous research has found that threat vigilance in deployed soldiers without PTSD was comparable to non-deployed participants with PTSD (Kimble et al., 2013), thus implying that threat vigilance is a likely consequence of deployment and should not be pathologised in a military population. If the tendency to interpret information as threatening is due to combat exposure rather than simply to PTSD, it would be reasonable to expect that the veteran groups in the current study might not have differed on the BSIQ. In fact, the current findings indicated that veterans without PTSD not only differed from those with PTSD, they did not differ in negative interpretations relative to civilian controls. This suggests that interpretation bias was associated primarily with PTSD symptoms and somewhat independent of combat exposure.

Why did the two combat veteran groups differ? One possible explanation is that this reflects pre-existing differences in that they were subject to different risk factors prior to their experiences at war (e.g. early trauma etc.) that have been identified as relevant risk factors for PTSD (e.g. Shalev, 1996). If this was the case, it is possible that administering the BSIQ even prior to combat might have elicited group differences. A future study could examine this by administering the BSIQ pre- and post-deployment. Another possible explanation is that despite similar experiences of combat, veterans without PTSD were less successful in their reintegration into civilian life. This explanation is consistent with existing literature which suggests that combat veterans with PTSD may be adversely affected by difficulties after returning home in addition to experiencing warzone-related difficulties (e.g. Iversen et al., 2005). In particular, the literature suggests that combat veterans struggle in their relationships with others, report feelings of alienation and a sense of "us and them" (e.g. Hall, 2013). This might influence their perception that other people are threatening, which could in part account for the current pattern of findings. This is also indicated by the finding that group

differences tended to be exacerbated in ambiguous situations indicating threats from the external environment or from other people. For instance, in the scenario in which an acquaintance ignores the participant, feeling distant or alienated from others may be more likely to lead to the interpretation that the acquaintance is rude or angry, or offended.

A number of studies have examined cognitive biases in military populations using tasks that involve combat-related stimuli. The findings from these studies provide further evidence for the notion that the veterans with PTSD in the current study may have continued to be affected by their combat experiences to a greater extent than those without PTSD. For example, Kimble et al. (2002) found that veterans with PTSD were more likely to complete ambiguous sentences with military versus non-military words, and various studies have found that combat veterans with PTSD demonstrate greater attentional interference, specifically for combat-related words (Ashley et al., 2013; Olatunji et al., 2013). This body of research has focused on early stages of processing, using tasks involving single-world stimuli that yield reaction time data such as modified Stroop or dot-probe. These tasks, whilst theoretically very useful, are abstract and have limited generalisability. This suggests that further research may be needed in order to compare combat-related versus everyday stimuli in more ecologically valid, scenario-based tasks.

Taken together, it is possible that an attenuated threat response during reintegration into civilian life is associated with fewer adjustment difficulties, whereas the persistence of a threat response which is adaptive on deployment is associated with greater PTSD symptomatology. These potential integration challenges may have contributed to the current findings of group differences in interpretation bias. The current study administered the standard BSIQ (Clark et al., 1997) but included two novel aspects: participants were asked questions intended to tap into their tendency to catastrophise about the future and to establish their ability to cope with negative outcomes. These two aspects will now be discussed in turn.

4.2.2 Results in relation to catastrophising

In the current study, participants were instructed to imagine that the negative interpretation of the ambiguous scenarios was true and asked what the future would be like. The results showed that veterans with PTSD held more catastrophic beliefs about the future, whereby they felt the repercussions of negative interpretations would be more severe and insurmountable, than veterans without PTSD. Somewhat surprisingly, veterans with PTSD did not differ in comparison with civilian controls.

The rationale for investigating catastrophising about the future in this study was that catastrophising is thought to both predict and exacerbate PTSD symptoms (Jenness et al., 2016; Carty et al., 2011). Moreover, interpretation bias is one type of judgment bias (Constans et al., 2005) that emphasises people's judgments about current, ambiguous information. A second type of judgment bias is subjective risk bias; this describes the tendency to overestimate the likelihood of negative events taking place in the future. This bias has also been linked to PTSD, with symptoms associated with a propensity to judge future negative events as both more probable and more costly (Thrasher & Dalgleish, 1999; Warda & Bryant, 1998; Nortje et al., 2005). However, McManus and Ehlers (2008) found that in comparison with participants presenting with high levels of trait anxiety, those with PTSD tended to only demonstrate subjective risk bias in relation to scenarios that were similar to the type of traumatic event they had experienced. In the context of the current study, it was thus possible that participants with PTSD would not make more catastrophic judgements about the future relative to the control groups, since none of the scenarios related to combat. In fact, it was found that combat veterans with versus without PTSD were more likely to choose responses indicating that there would be negative consequences for the future and that these would be difficult to overcome. This finding provides some preliminary evidence for subjective risk bias in individuals with PTSD that generalises into multiple aspects of everyday life rather than remaining specific to situations related to traumatic events. However, further research exploring the influence of trauma-specific information on subjective risk bias (and other cognitive biases) is needed.

Contrary to expectations, although combat veterans with PTSD tended to make more negative judgments about the future than civilian controls, this difference did not reach significance. This could indicate a greater degree of relative resilience in the veterans without PTSD, a factor that will be discussed in greater detail in relation to coping.

4.2.3 Results in relation to coping

Coping was thought to be an important factor in the current study since it was possible that even if the two combat veteran groups did not differ in interpretation bias, they might differ in coping ability. This was examined in two ways; firstly, participants were asked to imagine that the worst-case scenario was true and to judge their ability to cope and secondly, a questionnaire measure of coping strategies was administered. As expected, combat veterans with PTSD had the lowest self-reported ability to cope in relation to potential worst-case

scenarios. This group was also less likely to use self-sufficient coping strategies (such as problem-solving, personal growth, humour and acceptance) and more likely to use avoidant coping strategies (such as denial, 'giving up' and drinking alcohol). Contrary to predictions, despite also having had combat exposure, veterans without PTSD generally viewed themselves as more able to cope with worst-case scenarios than civilian controls. This was the only difference between the two control groups, suggesting that although they made similar judgements about the likelihood and consequences of negative outcomes, combat veterans had increased resilience in the face of adversity. These findings will now be considered in relation to the literature on coping.

The ability to cope with and recover from adversity is a factor that both protects against the development of PTSD and promotes recovery (Agaibi & Wilson, 2005). 'Approach' strategies that involve both practical and emotional problem-solving and eliciting support from others are generally thought to be the most adaptive. By contrast, 'avoid strategies' such as mental or behavioural disengagement, denial and substance misuse, are considered to be maladaptive and confer risk of PTSD and other psychopathology (Agaibi & Wilson, 2005; Litman, 2006). Research suggests that both cognitive appraisals and coping factors are associated with neurochemical responses to stress (Olff et al., 2005), and that cognitive bias directly influences PTSD symptoms but is also mediated by coping ability (Lambert et al., 2013). Given the association between poor coping and PTSD, it was unsurprising that the veteran participants with PTSD in the current study rated themselves as less able to cope with the worst-case scenarios than both veteran and civilian control groups.

Although differences between the two control groups were not initially predicted, it could be argued that greater self-reported coping ability in the veterans without PTSD as compared with civilians is consistent with the literature relating to military training and culture. For instance, military personnel are trained to cope with adverse situations in the context of war; enhanced general coping ability may be an enduring beneficial impact of this training. Another possible factor that may have contributed to different self-reported coping ability between the two control groups is the automaticity with which military personnel become accustomed to responding to hostile situations; a tendency to go into 'auto pilot' when faced with adversity may be protective in the long-term. Brim (2013) has also described 'warrior ethos' as an aspect of military culture; this endorses the suppression of emotions and the tolerance of pain. It might have been reasonable to expect that individuals who subscribe to this ethos might overreport their ability to cope with adversity, not wishing to 'make a fuss'

or to appear weak. However, this seems unlikely, since veterans without PTSD did not report using more avoidant coping strategies than the other groups, and their self-reported use of emotion-regulation coping strategies and those involving seeking emotional support from others was comparable to controls. This suggests that veterans without PTSD may use similar strategies to civilians without PTSD when coping with adversity but have a higher threshold for what constitutes adversity. It is possible that the combat veterans without PTSD had extensive experience of tackling stressful situations whilst at war. They may thus have had a range of problem-solving strategies to draw upon, and greater confidence in their ability to overcome adversity. It is also possible that combat experiences involving life or death situations result in greater resilience to more commonplace negative events. This is consistent with the above finding that combat veterans with PTSD made significantly more catastrophic judgments about the future than those without PTSD, but did not differ significantly from civilian controls. This finding is also consistent with research suggesting that veterans may experience 'post-traumatic growth', or PTG, which has been described as positive, meaningful psychological changes arising from traumatic experiences, such as a sense of purpose or renewed appreciation for life (see Habib et al., 2018 for a review).

What significance do the findings in relation to coping have for understanding combat-related PTSD? It is important to note that in the current study, the direction of findings was unclear. It was not necessarily the case that combat experiences increased resilience, it is equally possible that people with greater coping ability or resilience choose to join the military in the first place. Regardless of the cause, a high level of psychological resilience is likely to be a feature of military culture and combat experiences that is undermined by PTSD. There may be a relationship between coping ability and reintegration into civilian life that can maintain or exacerbate symptoms. For instance, veterans without PTSD may feel more able to overcome the challenges associated with reintegration and may even experience relief and pleasure when faced with the prospect of resuming civilian roles and activities. Opportunities to re-engage in meaningful activity and social relationships may reinforce their perception that they are able to cope. By contrast, veterans with PTSD might struggle to seamlessly reprise all aspects of their civilian life; this in turn limits opportunities for social support that might otherwise help them to cope with symptoms. Persistent PTSD symptoms such as avoidance, vigilance and changes in mood may further alienate people's loved ones, and also impact coping ability. The current findings may therefore reflect a complex interplay between PTSD symptoms and coping ability. Further exploration of coping strategies, both when deployed and upon return, may be a useful direction for future research.

The results discussed so far have highlighted interpretation bias, catastrophising and poor coping as factors that may maintain or exacerbate symptoms of combat-related PTSD. The cognitive model of PTSD is a theoretical framework that outlines the development and maintenance of PTSD, and the results will now be discussed in relation to this overarching model.

4.2.4 Results in relation to cognitive model of PTSD

How do cognitive models conceptualise the development and maintenance of PTSD in the general population? People are thought to have limited information processing capacity and thus to approach judgments and decisions on the basis of predisposition and subjective experience (Greifeneder et al., 2017). Subjective experience is key in the development of PTSD, since research suggests that factors such as perceived threat to life and 'mental defeat' (whereby people 'give up' during traumatic events and subsequently feel dehumanised and lacking in autonomy and self-esteem; Wilker et al., 2017) confer significant risk for people who have experienced a traumatic event (e.g. Alvarez-Conrad et al., 2001; Ehlers et al., 2000). Thus, for participants in the current study, it is possible that irrespective of the level of combat exposure, veterans with PTSD tended to appraise situations differently and judge the level of threat or long-term consequences to be more severe than those without PTSD. In line with cognitive models (e.g. Beck, 1963), these appraisals may have arisen from core beliefs. For instance, veteran participants with PTSD may have developed fundamental beliefs about the world being dangerous as a consequence of traumatic combat experiences that lead them to systematically overestimate threat. This overestimation of threat is consistent with research evidence suggesting that when faced with ambiguous information, people with PTSD may preferentially access negative or threat-related interpretations at the expense of more benign interpretations (Beck & Clark, 1997; Bomyea et al., 2017).

An association between combat-related PTSD and cognitive biases arising from subjective experience may be further supported by the current findings relating to scenario type. It was found that group differences tended to be exacerbated for situations involving external threats (general events and interactions with people) versus internal threats (bodily symptoms of panic or other health conditions). It may be the case that combat veterans with PTSD were accustomed to ignoring pain or physical discomfort but continued to struggle with memories of the external threats faced in a warzone. It is arguable that if past experiences of external threat predispose individuals to interpret ambiguous situations as threatening, the

two combat veteran groups should not have differed in their responses on the BSIQ. However, for those with PTSD, memories of past events tend to present a current sense of threat. The veterans with PTSD may therefore have had easier on-going access to threatening interpretations than those without PTSD. Moreover, the cognitive model indicates that triggers that produce a current sense of threat can become increasingly generalised (for example, a car backfiring initially produces the same emotional response as the sound of a gun being fired; eventually any loud noise produces this response; Ehlers & Clark, 2000). This could account for the fact that the combat veterans with PTSD endorsed more negative interpretations despite the scenarios being unrelated to combat. Taken together, the current findings, pertaining specifically to combat-related PTSD, are consistent with the cognitive model of PTSD in the general population, which particularly emphasises the role of cognitive appraisals in maintaining a continual sense of threat. However, it is important to consider the limitations of the cognitive model of PTSD. Whilst it offers a coherent account of the development and maintenance of symptoms of PTSD following singular traumatic events, it is less well-suited to conceptualising complex PTSD, following prolonged or repeated traumatic events (such as torture, slavery, or childhood sexual abuse; Cloitre, 2009). In contrast, theories underlying schema therapy, which considers developmental history and early maladaptive schemas, may help to conceptualise chronic or complex forms of PTSD, stemming from early traumatic experiences (Boterhoven de Haan et al., 2019). Neurocognitive theories underlying Narrative Exposure Therapy (NET) propose a network of interrelated sensory, cognitive emotional and physiological elements that represent multiple traumatic events. This network describes how an element from one event can trigger elements from others (Neuner et al., 2008). Although these alternative approaches offer some promise, the evidence base is currently weak in comparison with trauma-focused cognitive behavioural therapy (TF-CBT), which has been most thoroughly researched (e.g. Cusack et al., 2016; NICE, 2018). This may be because complex PTSD, which includes difficulties in emotional regulation and interpersonal relationships and strong negative beliefs about oneself over and above prerequisite diagnostic criteria for PTSD, has only recently been recognised as a formal diagnosis (ICD-11; World Health Organisation, 2018). Further research is therefore needed to develop a comprehensive psychological model of complex trauma.

4.3 LIMITATIONS

It is important to consider the limitations of the current study. With respect to the study procedure, there was some risk of selection bias, since the recruitment methods varied between the three groups. However, this was to some extent unavoidable, since combat veterans are a specialist population and it is highly impractical to recruit them from the same source as civilians. A second procedural limitation was that telephone support was available to combat veterans. This was an ethical consideration, given the potential risks of describing negative events to individuals who were likely to have experienced high levels of stress over prolonged periods. For practical reasons, this was not offered to civilian participants. However, although a researcher was available by telephone to address any emotional difficulties or upsetting memories should they arise, participants did not in practice request assistance with the task, and did not report any practical or emotional difficulties completing the study. A small number of participants wished to discuss their past experiences very briefly, and this was facilitated, but these conversations took place at the end of the study. It was therefore unlikely that the availability of telephone support directly influenced task performance. Nonetheless, inconsistences in recruitment and task administration are potential confounding factors that could be amended in any future iterations of this study.

There were also some limitations in terms of the sample of participants. For instance, combat exposure was not directly measured in the current study. Doing so may have strengthened the argument that the group differences were a consequence of PTSD rather than combat exposure. Nonetheless, only combat veterans were recruited and they were likely to have deployed to similar operations (specifically Iraq and Afghanistan). Another potential drawback was that the sample in the current study only involved male participants. This reflected the fact that the majority of combat personnel are male; recruiting an equal number of male and female participants would thus have been unrepresentative and including a small minority of female participants may have introduced a confound that would be difficult to control for. However, this neglects female experiences of PTSD in the military, which may have a distinct profile. For example, the literature has identified that female combat personnel who deploy are at increased risk of sexual harassment or assault (e.g. Leardmann et al., 2013), which in turn predicts PTSD (Kang et al., 2005). Future studies might therefore benefit from examining processes such as interpretation bias in female combat veterans.

Finally, it is important to consider potential limitations in the study design. The BSIQ has been a useful means of assessing interpretation bias in a range of anxiety disorders, including

PTSD (Lambert et al., 2013), and elicited group differences in the current study. However, there are some weaknesses in its design. Firstly, participants were asked to generate responses to and rank order explanations for all scenarios to start with, and then to re-read and provide ratings for scenario explanations. The rationale for asking ordering the questions in this way is to preclude interference between the ranking and rating questions but doing so introduces potential order effects. Secondly, it is unclear whether there is a meaningful distinction between the ranking and rating questions, since both elicit estimates of the likelihood of negative outcomes, and indeed the same pattern of results was found in relation to both questions in the current study. Future studies involving the BSIQ might therefore consider only asking a ranking or rating question, or using different sets of scenarios for these two scenario types. Lastly, the magnitude of potential negative consequences varies widely within and between scenario types in the BSIQ. For instance, in the example items described in Figure 2.1, a standoffish acquaintance or difficult work situation are unlikely to involve the same catastrophic consequences as a diagnosis of cancer or a heart defect. Future studies could refine the BSIQ to account for this inconsistency.

Despite its limitations, the current study provides a novel contribution to the literature. In particular, although interpretation bias has clear relevance for PTSD, it has historically been underrepresented in the PTSD literature in comparison with attentional and memory biases (Bomyea et al., 2017). Moreover, the current study attempts to disentangle the relative contributions of combat exposure and PTSD symptoms by including both veteran and civilian control groups. The findings from the current study also have potential implications for further research and clinical practice; these will be outlined below.

4.4 IMPLICATIONS FOR FURTHER RESEARCH

A number of potential research directions have emerged from the current findings. These primarily fall into two categories: research relating to clinical populations and research relating to task design. With respect to populations, the literature suggests that people with PTSD stemming from different sources of trauma may present with different symptoms. The current study focused on combat veterans, partially because this population often has more severe and enduring symptoms and takes a long time to seek support from mental health services (Murphy & Busuttil, 2014). The current study compared combat veterans with PTSD against both non-PTSD veteran and civilian control groups in order to disentangle the relative contributions of PTSD symptoms and combat exposure. To elucidate this further, future studies could include a fourth group: civilians with PTSD. Future studies

could also investigate interpretation bias in other populations presenting with complex PTSD or who have experienced prolonged periods or multiple instances of exposure to trauma, such as refugees, victims of trafficking, or those working in the emergency services.

One possible account of the current findings was that attenuated threat response when reintegrating into civilian life is associated with fewer adjustment difficulties, whereas the persistence of combat-level threat response is associated with greater PTSD symptomatology. However, this is a post-hoc explanation that not necessarily help predict PTSD; a longitudinal study may therefore be of value. Specifically, comparing different groups at multiple timepoints, (for instance, prior to deployment, immediately after discharge from service and after a period of reintegration into civilian life) might contribute to an understanding of the development of cognitive bias. Administering measures of cognitive bias alongside measures examining personality traits and early life history prior to deployment and might also illuminate the extent to which these factors confer vulnerability to PTSD.

With respect to task design, the findings from the current study could be taken further by introducing various experimental manipulations. Firstly, a scenario-based task such as the BSIQ could be manipulated such that half the items pertain to everyday ambiguous situations in civilian life and the remaining half pertain to ambiguous situations in warzones. This might be particularly relevant given the findings from previous studies of cognitive bias indicating that results may vary depending on the match between task stimulus and the traumatic event experienced. In addition, this design might further help to unpick the influence of combat exposure versus PTSD. On the one hand, group differences might be less pronounced in combat-related scenarios, due to shared experiences and similar training. Alternatively, group differences might be preserved across scenario types, since veterans with PSTD may struggle with a persistent sense of current threat. In general, future studies may also benefit from the development and validation of a battery of military-specific scenario-based tasks.

Secondly, future research could further explore factors such as beliefs about negative outcomes in the future or coping ability. This might involve inviting participants to generate more verbal explanations in addition to providing an explanation for ambiguous situations. For instance, they could describe what they expect will happen next, what the future will be like, and what they would do in order to cope. This might reveal a more nuanced understanding of subjective risk bias and specific coping strategies.

Lastly, task scenarios could be systematically manipulated to include low threat versus high threat versions. They could also be manipulated to vary the degree of ambiguity in the situation. This might help to establish different thresholds at which situations are perceived to be threatening, which could have potential implications for symptom amelioration. This will be discussed alongside other potential clinical implications below.

4.5 IMPLICATIONS FOR CLINICAL PRACTICE

Before discussing potential clinical implications of the current study, it is worth briefly reviewing the challenges facing clinicians considering combat-related PTSD. At present, packages of support are available to aid reintegration into civilian life and prevent psychological ill health amongst combat personnel (e.g. Greenberg et al., 2008; Frappell-Cooke et al., 2010; Fertout et al., 2011). These programmes are thought to boost resilience, help to reduce alcohol misuse and general mental distress, but few interventions exist to prevent the development of PTSD (Fertout et al., 2011; Mulligan et al., 2013). Moreover, the evidence suggests that combat personnel with PTSD are reluctant to seek support for mental health difficulties (Hoge et al., 2004), view these difficulties as less legitimate than physical ailments (Forbes et al., 2012; Murphy & Busuttil, 2014) and are distrusting of those providing mental health support (French et al., 2004).

The research presented in the current study is primarily mechanistic but may shed some light on factors to consider when refining treatment of combat-related PTSD. Firstly, as described above, the current approach to investigating interpretation bias may help to establish different thresholds at which ambiguous information is perceived as threatening for different participant groups. This may in turn have potential implications for the development of skills training programmes to reduce interpretation bias. These could involve supporting individuals to generate a broader range of interpretations. Treatment analogues exist in the attentional bias literature; for instance, studies have shown that measures of attentional bias can be used as part of a skills training programme both to reduce bias and to ameliorate PTSD symptoms (Wald et al., 2016). However, these are dot-probe type tasks that have limited real-world applicability. Alternatively, the current study highlights the strengths of scenario-based, more ecologically valid tasks in identifying cognitive bias and these methods could feasibly be adapted as a treatment programme. Secondly, training programmes that specifically target combat-related experiences could be developed. For example, scenarios that would enable clients to practise identifying the similarities and differences between their environment when deployed versus at home might help to reduce a current sense of threat.

Another potential clinical implication of the current findings relates to the role of coping, since participants with PTSD reported lower ability to cope and a more avoidant coping style relative to controls. Future clinical interventions for combat-related PTSD could therefore focus on assessing coping style and developing alternative, more adaptive coping strategies. This approach is consistent with evidence suggesting that coping strategies are malleable (Nielson & Knardahl, 2014). Finally, veterans currently report a significant number of barriers to them accessing support. These include a perceived lack of understanding from general mental health services, a lack of knowledge regarding the support that is available and in particular internalised stigma (whereby people judge themselves negatively as a result of their mental health difficulties; Murphy & Busuttil, 2015). A recent review found that supporting individuals to reduce internalised stigma is a vital step in enabling military personnel to engage in help-seeking behaviour (Murphy & Busuttil, 2015). It is theoretically possible that a systematic tendency to interpret ambiguous behaviour in others (e.g. general mental health services) as negatively-intentioned or judgmental, a tendency for general mental health services to lack specialised knowledge about military culture, and a tendency for military personnel to favour peer support are all factors that perpetuate barriers to help-seeking. Therefore, in the long-term, treatment of combat-related PTSD may be optimised by the armed forces and general mental health services working more collaboratively to develop a shared understanding of combat-related mental health difficulties and to facilitate improved trust in services.

4.6 CONCLUDING COMMENTS

The present study was designed to investigate interpretation bias in combat veterans with and without PTSD. A civilian control group was also included, in order to elucidate the contributions of combat exposure versus PTSD symptomatology. The findings revealed that veterans with PTSD tended to interpret ambiguous scenarios more negatively and judged negative interpretations to be more likely than did the veteran and civilian control groups. This suggests that interpretation bias may be a feature of combat-related PTSD. Moreover, the two control groups did not differ, indicating that interpretation bias is associated with PTSD rather than combat exposure. The current study also found that veterans with versus without PTSD judged the future to be more catastrophic, which has preliminary implications for the role of subjective risk bias. Lastly, veterans with PTSD judged themselves to be less able to cope with adversity and used more avoidant coping strategies in comparison with both control groups. The two control groups generated similar interpretations for ambiguous

events and made similar judgments about the likelihood and consequences of negative interpretations. They also did not differ in their self-reported coping strategies. However, veterans without PTSD rated themselves as more able to cope with adversity than did civilian controls. This suggests that veterans without PTSD may have been particularly resilient. Taken together, the current study offers a novel contribution to the literature, since it was focused on interpretation bias (which has been comparatively understudied), used a relatively ecologically valid task, and expanded understanding of combat-related PTSD. The findings also have implications for both further research and clinical practice.

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APPENDIX 1: ETHICS APPROVAL LETTER

Research Ethics
Office

Franklin Wilkins Building
5.9 Waterloo Bridge Wing
Waterloo Road
London SE1 9NH
Telephone 020 7848 4020/4070/4077
rec@kcl.ac.uk

KING'S College LONDON

Karishma Vyas

14 March 2018

Dear Karishma,

Study Title: Interpretation of Ambiguous Situations in Combat Veterans with vs. without PTSD

Study Reference:HR-17/18-5398

I am pleased to inform you that full approval for your project has been granted by the PNM Research Ethics Subcommittee .

For your information, ethical approval has been granted for 3 years from 14 March 2018. If you need approval beyond this point, you will need to apply for an extension at least two weeks before this. You will be required to explain the reasons for the extension. However, you will not need to submit a full reapplication unless the protocol has changed.

Ethical approval is required to cover the data-collection phase of the study. This will be until the date specified in this letter. However, you do not need ethical approval to cover subsequent data analysis or publication of the results. For secondary data-analysis, ethical approval is applicable to the data that is sensitive or identifies participants.

Please ensure that you follow the guidelines for good research practice as laid out in UKRIO's Code of Practice for research:
http://www.kcl.ac.uk/innovation/research/support/conduct/cop/index.aspx

Please note you are required to adhere to all research data/records management and storage procedures agreed to as part of your application. This will be expected even after the completion of the study.

If you do not start the project within three months of this letter, please contact the Research Ethics Office.

Please note that you will be required to obtain approval to modify the study. This also encompasses extensions to periods of approval. Please refer to the URL below for further guidance about the process:

http://www.kcl.ac.uk/innovation/research/support/ethics/applications/modifications.aspx

Please would you also note that we may, for the purposes of audit, contact you from time to time to ascertain the status of your research.

If you have any query about any aspect of this ethical approval, please contact the Research Ethics Office:

(http://www.kcl.ac.uk/innovation/research/support/ethics/contact.aspx)

We wish you every success with this work.

Yours sincerely,

Mr James Patterson
Senior Research Ethics Officer

For and on behalf of

Chair of the PNM Research Ethics Subcommittee

APPENDIX 2: COMBAT STRESS COVER LETTER

Dear XXX

My name is Kari and I am a trainee clinical psychologist based at Kings College London. I am writing to you to tell you about a study I am running. I am interested in learning about how combat veterans make sense of ambiguous everyday situations. My study will involve reading short descriptions of everyday situations and answering questions about what you think is going on. This is an online study, although I will also phone you to answer any questions that may come up while you are taking part. It should last no more than an hour, and you will be paid £15 as a thank you for your time.

Combat Stress have very kindly agreed to send this letter on my behalf, but have not passed your details to me directly. If you think you might be interested in taking part, you can read a more detailed information sheet attached to this letter. If you decide to take part, or if you have any questions you would like to ask me, you an email me on: VASS@kcl.ac.uk. Alternatively, you can send the attached opt-in form to the address below.
Please remember that whatever you decide, this will have no impact on your treatment at Combat Stress. Thank you for taking the time to read this letter.

Best wishes,
Kari

Dr Kari Vas
ASB, 4 Windsor Walk
Denmark Hill
London, SE5 8BB
VASS@kcl.ac.uk

APPENDIX 3: COMBAT STRESS ONLINE ADVERT

Paid Combat Veteran Study

Many veterans suffer with PTSD following their experiences in combat. Learning more about how these experiences shape the way they see the world might be an important step in improving psychological support available to veterans. I am therefore running a study looking at how combat veterans with PTSD make sense of ambiguous everyday situations. My study involves reading short descriptions of everyday situations and answering questions about what you think is going on.

This is an online study, although I will also phone you to answer any questions that may come up while you are taking part. It should last no more than an hour, and you will be paid £15 as a thank you for your time.

You can take part in this study if you are:

- Male
- A combat veteran
- Living with a diagnosis of PTSD

If you are interested in taking part or if you have more questions you would like to ask before deciding, please email me on: vass@kcl.ac.uk

Thank you for taking the time to read this.

APPENDIX 4: KCMHR (NON-PTSD COMBAT VETERANS) COVER LETTER

Dear XXX

My name is Kari and I am a trainee clinical psychologist based at Kings College London. I am writing to you to tell you about a study I am running. I am interested in learning about how combat veterans make sense of ambiguous everyday situations. My study will involve reading short descriptions of everyday situations and answering questions about what you think is going on. This is an online study, although I will also phone you to answer any questions that may come up while you are taking part. It should last no more than an hour, and you will be paid £15 as a thank you for your time.

If you think you might be interested in taking part, you can read a more detailed information sheet attached to this email. If you decide to take part, or if you have any questions you would like to ask me, you an email me on: VASS@kcl.ac.uk.

Alternatively, you can simply email the attached opt-in form, or send it to the address below.

Thank you for taking the time to read this email.

Best wishes,
Kari

Dr Kari Vyas
The King's Centre for Military Health Research (KCMHR)
King's College London
Weston Education Centre
Cutcombe Road
London
SE5 9RJ
VASS@kcl.ac.uk

APPENDIX 5: CIVILAN CONTROLS ONLINE ADVERT

PAID STUDY: How do you interpret everyday, ambiguous situations?

My name is Kari and I am a trainee clinical psychologist based at Kings College London. I am interested in learning about how combat veterans make sense of ambiguous everyday situations. In order to explore this question, I would also like to see how people without any military experience respond.

My study will involve reading short online descriptions of everyday situations and answering questions about what you think is going on. It should last no more than an hour, and you will be paid £15 as a thank you for your time.

You can take part if:

- You are male
- You are over the age of 18
- You have no military experience
- You have never been given a diagnosis of Post-Traumatic Stress Disorder

If you are interested in taking part, you can access the study using the following weblink:

https://kings.onlinesurveys.ac.uk/combat-veteran-study-civilian

If you have any questions you would like to ask me, you an email me on: VASS@kcl.ac.uk.

Thank you for taking the time to read this information.

Best wishes,
Kari

APPENDIX 6: STUDY INFORMATION SHEET

INFORMATION SHEET FOR PARTICIPANTS

REMAS Reference Number: HR-17/18-5398

Invitation to take part in research study: Everyday Interpretations in Combat Veterans with and without PTSD

Dear Participant,

We would like to invite you to take part in a research study being undertaken by Dr Kari Vyas of the Kings Centre of Military Health Research, Professor Neil Greenberg of the Academic Department of Military Mental Health, King's College London and Dr Dominic Murphy, clinical psychologist with Combat Stress. You should only participate if you want to; choosing not to take part will not disadvantage you in any way. Before you decide whether you want to take part, it is important for you to understand why the research is being done and what your participation will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information.

Why are we carrying out this study?
The purpose of this study is to explore the relationship between post-traumatic stress in combat veterans and interpretations of everyday situations.

This information will contribute to greater understanding of the profile of strengths and difficulties of combat veterans who have experienced extremely stressful circumstances whilst deployed. In the long-term, this will hopefully promote more specialised packages of support for veterans experiencing difficulties after returning home. This study shall also contribute towards a Doctorate in Clinical Psychology qualification for Kari Vyas.

Confidentiality
All of the information that you provide will be anonymised and stored securely in one of two ways. Any paper documentation will be stored in a locked filing cabinet. Electronic files will be password-protected. None of the data we collect will have any directly identifiable information about you stored with it. We can assure you that *none* of the information you provide will be communicated back to the military in any way that you will be identified. You have our full assurance that we take confidentiality very seriously indeed.

What will happen if I agree to take part?
If you are interested in taking part, we will arrange a date and time at your convenience. The study involves completing an online survey. You will read about a variety of everyday situations, and you will be asked to answer questions about what you think is happening. The online survey also includes two other brief questionnaires – one about challenging circumstances you may have experienced or difficult memories of these circumstances, and one about your coping strategies. We will send you the website address for this survey via email. Kari Vyas, the trainee clinical psychologist running this study, will also call you on the telephone to provide support while you complete the online survey, and

to clarify any questions you may have. The duration of the study will be at most 1hour, and you will be paid £15 for your participation.

Are there any risks?
If you agree to take part in this study, you will read about various situations and make judgments about what is happening. Some of these situations could be interpreted as uncomfortable. For example, they may describe a person looking unhappy or experiencing some physical discomfort. The risks in this study are therefore minimal. However, some people may find the descriptions of everyday situations somewhat distressing. Please note that if you were to feel very distressed, you can stop the study at any time or request a break without giving a reason. You may also express any concerns about the study or discuss any feelings of distress with the trainee clinical psychologist on the phone. If you change your mind about participation, you may also choose to withdraw your data from the study for up to 28 days after you take part, without giving a reason.

What will happen after the study?
After you complete the online survey, you will have the opportunity to discuss any thoughts you had during the study. If you would like to receive a copy of the overall study results, this can be arranged. Upon completion of the project, the findings will be written up in a doctoral thesis and will eventually be submitted for publication in a peer-reviewed journal. The write-up will be a summary of all data and will not contain personal information about any research participants.

How do I take part?
If you are interested in taking part in the study and are willing to be contacted via the telephone to discuss participation further, please fill in your telephone details in the attached consent form and return it to me via the email address below. You can also use these contact details if you have any general queries about the study.

Best wishes,
Kari Vyas

Dr Kari Vyas
The King's Centre for Military Health Research (KCMHR)
King's College London
Weston Education Centre
Cutcombe Road
London
SE5 9RJ
VASS@kcl.ac.uk

If this study has harmed you in any way, you can contact King's College London using the details below for further advice and information:
Professor Neil Greenberg, Academic Department of Military Mental Health,
King's College London, Weston Education Centre, 10 Cutcombe Road, London SE5 9RJ
Telephone: 020 7848 5408, Email: neil.greenberg@kcl.ac.uk

APPENDIX 7: STUDY CONSENT FORM

Thank you for considering taking part in this research. Please complete this form after you have read the Information Sheet on the previous page.

Title of Study: Everyday Interpretations in Combat Veterans

REMAS Reference Number: HR-17/18-5398

Please tick or initial the boxes below:

1. **I confirm that I have read and understood the information sheet dated [INSERT DATE AND VERSION NUMBER] for the above study. I have had the opportunity to consider the information and asked questions which have been answered satisfactorily.** ☐

2. **I understand that I will be able to stop participating in this study at any time and to withdraw my data up to 28 days after participating without giving a reason** ☐

3. **I consent to the processing of my personal information for the purposes explained to me. I understand that such information will be handled in accordance with the terms of the UK Data Protection Act 1998.** ☐

4. **I understand that my information may be subject to review by responsible individuals from the College for monitoring and audit purposes.** ☐

5. **I understand that confidentiality and anonymity will be maintained and it will not be possible to identify me in any publications** ☐

6. **I agree to be contacted in the future by King's College London researchers who would like to invite me to participate in follow up studies to this project, or in future studies of a similar nature.** ☐

Name: _____

Date: _____